



FIELD CROP PROTECTION GUIDE

2009 - 2010

Publication 812

Discard old editions of this publication. Each year the appropriate sub-committee of the Ontario Pest Management Research and Services Committee reviews the pesticides listed in this publication. To the best knowledge of the committee, at the time of printing, the pesticide products listed in this publication were:

- federally registered
- classified by the Ministry of the Environment (MOE).

The information in this publication is general information only. The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) does not offer any warranty or guarantee, nor does it assume any liability for any crop loss, animal loss, health, safety or environmental hazard caused by the use of a pesticide mentioned in this publication.

This publication lists a number of brand names of pesticides. It is neither an endorsement of the product nor a suggestion that similar products are ineffective.

The Pesticide Label

Consult each product label before you use a pesticide. The label provides specific information on how to use the product safely, hazards, restrictions on use, compatibility with other products, the effect of environmental conditions, etc.

The pesticide product label is a legal document. It is against the law to use the product in any other way.

Federal Registration of Pesticide Products

The Pest Management Regulatory Agency (PMRA) of Health Canada registers pesticide products for use in Canada based on following an evaluation of scientific data to ensure that the product has merit and value; and the human health and environmental risks associated with its proposed use are acceptable.

1. Full Registration

Pesticide registrations are normally granted for a period of five years, subject to renewal.

2. Conditional Registration

Conditional registration may be granted for a specified, limited time period, where the registrant agrees to produce additional scientific or technical information, or the pesticide is used for emergency control of a serious pest outbreak.

Maximum Residue Limits

The PMRA has established maximum residue limits (MRLs) for pesticides.

Processors or retailers may demand more restrictive limits. Growers should seek advice of their intended market to determine if more restrictive limitations apply. Keep accurate and up-to-date records on pesticide use in each crop.

Supplemental Labels

You **MUST** obtain a supplemental label and follow all the label directions when PMRA approves new uses for a registered pesticide that do not appear on the current label.

Examples of when you must use a supplemental label include:

- **Emergency Use Registration**
- **Minor Use Label Expansion**

You can obtain a copy of a supplemental label from the pesticide manufacturer or pesticide vendor, the grower association that sponsored the emergency registration or minor use, from OMAFRA or PMRA's Pest Management Information Service.

For more information on the federal registration status check the PMRA website at www.pmr-arla.gc.ca or call 1-800-267-6315.

Regulation of Pesticides in Ontario

The MOE is responsible for regulating pesticide sale, use, transportation, storage and disposal in Ontario. Ontario regulates pesticides by placing appropriate education, licensing and/or permit requirements on their use, under the *Pesticides Act* and Regulation 63/09.

All Pesticides must be used in accordance with requirements under the *Pesticides Act* and Regulation 63/09, which are available on the e-laws website at www.e-laws.gov.on.ca or call ServiceOntario Publications Toll-Free number: 1-800-668-9938 or 416-326-5300.

Classification of Pesticides

The Ontario Pesticides Advisory Committee (OPAC) is responsible for reviewing and recommending to the MOE, the classification of pesticide products before they can be sold or used in Ontario. Once approved by the MOE, classified products are posted on the MOE website at www.ene.gov.on.ca.

Certification and Licensing

Growers and their Assistants

For information about certification for growers and training for assistants check the Ontario Pesticide Education Program website: www.opec.ca or call 1-800-652-8573.

Commercial Applicators and their Assistants

For more information about exterminator certification and licensing and technician training check the Ontario Pesticide Training & Certification website at www.ontariopesticide.com/OPTC/default.htm or call 1-888-620-9999 or 519-674-1575.

Cette publication est aussi disponible en français.



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Acknowledgements

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Need technical and business information?

Contact the Agricultural Information Contact Centre at

1-877-424-1300

or ag.info.omafra@ontario.ca

Looking for field crop production information on the Internet?

Check the OMAFRA website at
www.ontario.ca/omafra

You will find a comprehensive collection of Factsheets, articles and photos regarding the production and maintenance of field crops.

This publication contains all pesticide products and IPM strategies recommended by OMAFRA for the control of major field crop pests of Ontario. For information related to production, harvest, storage and pest life cycles, identification and other management strategies, see OMAFRA Publication 811, *Agronomy Guide for Field Crops*. Information on ordering OMAFRA publications is found on the inside back cover of this book. Supplements to this publication will be posted to the OMAFRA website.

Cover Images

FRONT:	Large left:	Powdery mildew on soybean leaf	Small left:	Gibberella ear rot infection on corn
	Large right:	Bean leaf beetle on a seedling soybean plant	Small centre:	True armyworm
			Small right:	Phomopsis seed mould on soybeans
BACK:	Large left:	Northern leaf blight on corn	Small left:	Western bean cutworm damage
	Large right:	Western corn rootworm	Small centre:	Green stink bug adult
			Small right:	Soybean root with SCN cysts

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Introduction

How Products Are Listed in This Book

Only products recommended for use by the Field Crop Protection Subcommittee are listed in this book.

Placement of products under each pest is based on three criteria:

- efficacy (effectiveness at controlling the pest)
- safety to the user
- safety to the environment
 - biological options
 - reduced risk options
 - compatibility in an integrated pest management program
 - safety to beneficials (non-target species)

When two products have similar efficacy against one pest, the product that is lower in risk to both the environment and the applicator will appear first in the recommendation list.

Newly registered products are generally placed at the bottom of the recommendation list, unless research has proven that the product is superior to the other products already listed under that pest and crop.

Within this publication where rate ranges exist, consult the product label to determine what rate is most appropriate for your pest situation.

Resistance Management Strategies

Different pesticides control pests in different ways. This is called the mode of action. Pesticides are grouped into chemical families/groups based on their mode of action. Using the same pesticide with the same mode of action season after season or several times within the same season could result in the target pest becoming resistant to the chemical family. A pest can develop resistance to one chemical family but still be very susceptible to another. Therefore, to reduce the risk of a pest developing resistance, rotate between chemical groups/families within the same season or during successive growing seasons for control of the same pest. For example, if using a Group 11 fungicide (e.g., Quadris) to control rust in corn, and more than one application is required that season to manage the disease, use a product from a different group (e.g., Tilt fungicide, which is a Group 3 fungicide) for the second application, because it controls the disease using a different mode of action. Pesticide labels indicate which chemistry group or family that product belongs in. For a list of insecticide and fungicide chemical groups, see Appendix G, *Pesticide Groups Based on Sites of Action*, on page 96.

Only use chemical control when necessary and consider implementing other forms of control such as cultural control (e.g., crop rotation, use of certified seed) or biological control to help reduce the risk of a pest developing resistance to a pesticide.

Do not exceed the total number of applications allowed per year for each product. Do not apply the product at rates lower than the recommended rate on the label.

Monitor recently treated pest populations for signs of resistance.

See the pesticide label for more information on resistance management. For more information on resistance management strategies or integrated pest management (IPM) options for a specific pest, contact your local OMAFRA extension specialist or certified crop advisor. IPM options are listed in the first column of the Chemical Control Options tables in this publication.

I. Corn (Field and Seed)

CORN INSECTS

Table I-1. Corn (Field and Seed) Seed and Soil-Applied Insecticide Recommendations

Active Ingredients	Trade Name	Formulation	Corn Insects				
			Corn Rootworm	European Chafer	Wireworms	Seedcorn Maggot	Black Cutworm
Seed Treatments							
Untreated Seed							
clothianidin	Poncho 600 at 0.25 mg ai per kernel (aka Poncho 250)	F	—	+	+	+	+
	Poncho 600 at 1.25 mg ai per kernel (aka Poncho 1250)	F	+	+	+	+	+
diazinon + captan	Agrox B-2	P (DB)	—	—	—	+	—
imidacloprid	Gaucho 480 FL	F	—	—	+	—	—
thiamethoxam	Cruiser 5 FS at 0.125 – 0.250 mg ai per kernel	F	—	+	+	+	—
	Cruiser 5 FS at 1.25 mg ai per kernel	F	+	+	+	+	—
Seed Pretreated With Fungicide							
diazinon + captan	Agrox CD	P (DB)	—		—	+	—
Soil-Applied Treatments							
chlorpyrifos	Lorsban 15 G	G	+		—	—	—
	Pyrifos 15 G	G	+		—	—	—
phorate	Thimet 15 G	G	+		—	—	—
tefluthrin	Force 3.0 G	G	+		+	+	S
DB = Drill Box Application F = Flowable G = Granular P = Powder							
+ = recommended for insect listed — = NOT recommended S = suppression							

CORN INSECTS

Table 1-2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
CORN ROOTWORM (<i>Diabrotica virgifera</i> and <i>Diabrotica barberi</i>)				
Soil-Applied at Planting Only			per 100-m (328-ft) row	
Avoid planting corn on corn. Crop rotation is the best strategy for control. Risk factors include heavier soil (clay), high beetle populations in corn of previous season, being the latest field planted in the previous season. If there is less than 1 beetle per corn plant on average throughout the month of August, then no insecticide is necessary in the following corn crop. In-furrow application is safer to the applicator and non-target animals than T-band application.	tefluthrin	Force 3 G	37.5 g	May be applied in a T-band or in-furrow. For banded applications, place directly over the furrow in a 15-cm band ahead of the press wheel. For in-furrow applications, place all material directly in the open seed furrow, behind the planter disc openers.
	chlorpyrifos	Lorsban 15 G	75 g	Must be applied in a 10–15-cm band over the row behind the planter shoe, in front of the press wheel. Do not place in direct contact with seed.
		Pyrifos 15 G	75 g	
	phorate	Thimet 15 G	75 g	Lock and load. Must be applied in a 10–15-cm band over the row behind the planter shoe, in front of the press wheel. Do not place in direct contact with seed.
Seed Treatment			per 80,000 kernels	
Seed treatments are best suited for those fields at high risk, especially corn after corn.	clothianidin	Poncho 1250	166.7 mL	For use in commercial seed treaters only. For low-to-moderate rootworm populations. Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
		Cruiser 5 FS	166.7 mL	For use in commercial seed treaters only. For low-to-moderate rootworm populations. Do not graze or feed livestock on treated areas for 45 days after planting.
Transgenic				
To manage potential rootworm resistance, plant a minimum of 20% of total corn acreage to non-Bt corn hybrids and position this refuge within or directly adjacent to the YieldGard Rootworm Bt corn field. Refuge can be treated for rootworm larvae with soil-applied insecticides if thresholds prescribe it. Insecticide use for adult control is not permitted. For more information regarding Bt corn and/or refuge options, see <i>A Grower's Handbook; Controlling Corn Insect Pests With Bt Corn Technology</i> , found at www.cornpest.ca .		Agrisure RW Herculex RW Herculex Xtra YieldGard RW YieldGard Plus YieldGard VT Triple	See Table 9–4, <i>Transgenic Crops Expressing Insecticidal or Fungicidal Traits</i> , on page 84, for Bt corn options.	Use Bt hybrids in fields of continuous corn with moderate-to-high populations of rootworm. Keep careful and accurate records as to where Bt and non-Bt hybrids are planted.

CORN INSECTS

Table 1-2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
WIREWORMS (<i>Limonius</i> spp. and others)				
Seed Treatment			per 80,000 kernels	
Risk factors include history of cereal/ corn/grassy weeds, sandy soils, history of wireworm problems, coming out of sod.	clothianidin	Poncho 250	33.3 mL	For use in commercial seed treaters only. Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
Threshold is one wireworm per bait trap. For bait trap information, see OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> .	imidacloprid	Gaucho 480 FL	27 mL	For use in commercial seed treaters only. Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
	thiamethoxam	Cruiser 5 FS	16.7 mL	For use in commercial seed treaters only. Do not graze or feed livestock on treated areas for 45 days after planting.
Soil Applied at Planting Only			per 100-m (328-ft) row	
In-furrow application is safer to the applicator and non-target animals than T-band application.	tefluthrin	Force 3 G	37.5 g	In-furrow only. Place directly in the seed furrow behind the planter disc openers.
MILLIPEDES (Various species)				
Can be a pest in cool, wet springs in fields with heavy residue or high organic matter. Can be misidentified as wireworms. Ensure proper identification has been made.				No registered products available at this time.
SEEDCORN MAGGOT (<i>Delia platura</i>)				
Seed Treatment			per 100 kg seed	
Seedcorn maggot problems in corn are extremely rare in Ontario. Use seed treatments in high-risk fields where large amounts of manure, green manure or residue have been recently incorporated, in fields that are freshly tilled or when cool, backward emergence conditions exist.	For all seed treatments use full rate and ensure good coverage of seed.			
	diazinon + captan	Agrox B-2	340 g	Available as 2-kg container that will treat 600 kg of corn seed. Do not use on seed already treated with an insecticide. Seed within 1 month of treatment.
		Agrox CD	200 g	Available as a 600-g container that will treat 300 kg of corn seed. Use this product only on seed previously treated with captan or thiram.
			per 80,000 kernels	
	clothianidin	Poncho 250	33.3 mL	For use in commercial seed treaters only. Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
	thiamethoxam	Cruiser 5 FS	16.7–33.3 mL	For use in commercial seed treaters only. Use the higher rate for fields that have a history of moderate-to-severe pest pressure. Do not graze or feed livestock on treated areas for 45 days after planting.

CORN INSECTS

Table 1–2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
Soil-Applied at Planting Only				
In-furrow application is safer to the applicator and non-target animals than T-band application.	tefluthrin	Force 3 G	per 100-m (328-ft) row 37.5 g	In-furrow only. Place directly in the seed furrow behind the planter disc openers.
SEEDCORN BEETLE (<i>Agonoderus lecontei</i> and <i>Clivina impressifrons</i>)				
Risk factors: no-till, cool, backwards spring, slow emergence conditions.				No registered products available at this time.
BLACK CUTWORM (<i>Agrotis ipsilon</i>)				
Soil-Applied at Planting Only			per 100-m (328-ft) row	
Risk factors: winter annual weeds and volunteer wheat before planting, no-till, heavy soybean residue. Control annual weeds at least 3 weeks prior to planting to reduce attraction by adult moths flying in from the U.S.	tefluthrin	Force 3 G	37.5 g	Soil-applied control is not as good as a well-timed rescue treatment. May be applied as a banded or in-furrow application. For banded applications, place directly in a 15-cm band ahead of the press wheel. For in-furrow application, place all material directly in the open seed furrow, behind the planter disc openers.
Seed Treatment			per 80,000 kernels	
Cutworm is a sporadic pest. Using seed treatments specifically for black cutworm control is not recommended unless the field has had a continuous history of cutworm injury.	clothianidin	Poncho 250	33.3 mL	For use in commercial seed treaters only. Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
Transgenic Corn				
		Herculex I Herculex Xtra	See Table 9–4, <i>Transgenic Crops Expressing Insecticidal or Fungicidal Traits</i> , on page 84, for Bt corn options.	Herculex varieties only. May only control young larvae.

CORN INSECTS

Table 1-2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
Rescue Treatments			per ha (per acre)	
Scout early! Cutworms are easier to control when small. Look for leaf-feeding (pinholes) by young climbing larvae as first sign of damage. If more than 10% of plants show leaf feeding, treating at this time will give nearly 100% control.	permethrin	Pounce EC	175–390 mL (70–156 mL)	Seedling stage only. Apply under warm, moist conditions in evening or night when cutworms are most active. Do not disturb soil for 5 days after application.
	cypermethrin	Ripcord 400 EC	175 mL (70 mL)	Seedling stage only. Apply under warm, moist conditions in evening or night when cutworms are most active. Do not disturb soil for 5 days after application. 21 days to harvest.
	chlorpyrifos	Lorsban 4E	1.2–2.4 L (480–960 mL)	Seedling stage only. 70 days to harvest.
		Pyrinex 480 EC	1.2–2.4 L (480–960 mL)	Seedling stage only. Apply once per season. 70 days to harvest.
	cyhalothrin-lambda	Matador 120 EC	83 mL (34 mL)	Seedling stage only. Ground and aerial application. Apply under warm, moist conditions in evening or night when cutworms are most active. Do not disturb soil for 5 days after application. 3 applications/season, 2 may be by air. 14 days to harvest.
Silencer 120 EC				
EUROPEAN CHAFER (<i>Rhizotrogus majalis</i>)				
Seed Treatment			per 80,000 kernels	
Avoid planting corn if grub population is extreme — plant soybeans instead. 2 or more larvae per square foot indicates the need for control. If grub populations are high (i.e., 5 or more grubs per square foot), use the higher rate of seed treatment.	clothianidin	Poncho 250	33.3 mL	For use in commercial seed treaters only. Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
	thiamethoxam	Cruiser 5 FS	16.7 mL	For use in commercial seed treaters only. Do not graze or feed livestock on treated areas for 45 days after planting.
See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for further information on insect biology and management options.				

CORN INSECTS

Table 1-2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
EUROPEAN CORN BORER (ECB) (<i>Ostrinia nubilalis</i>)				
To manage potential corn borer resistance, plant a minimum of 20% of total acreage to non-Bt corn refuge and position it so that the refuge is no more than 400 m from the Bt corn planting. Do not apply ECB insecticide to non-Bt refuge. For more information regarding Bt corn and/or refuge options, see <i>A Grower's Handbook; Controlling Corn Insect Pests With Bt Corn Technology</i> , found at www.cornpest.ca .		Agrisure CB Herculex I Herculex Xtra KnockOut NatureGard YieldGard YieldGard Plus YieldGard VT Triple	See Table 9-4, <i>Transgenic Crops Expressing Insecticidal or Fungicidal Traits</i> , on page 84, for Bt corn options	Insecticides have generally not provided economic control of ECB in field corn. Using Bt transgenic corn provides much better control. Use corn hybrids that express the Bt toxin in the ear as well as the stalk to help avoid stalk and ear rot. Keep careful and accurate records as to where Bt and non-Bt hybrids are planted.
			per ha (per acre)	
Seed Corn Only See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , to calculate economic thresholds.	deltamethrin	Decis 5.0 EC	250-300 mL (100-120 mL)	Ground and aerial application. Apply when egg masses begin to hatch but no later than when 1st pinhole feeding occurs on foliage. For 2nd brood in late planting, apply before tassels show. Repeat in 5-8-day intervals. Maximum 3 applications/yr. Do not feed silage or stubble to dairy cattle.
	cypermethrin	Ripcord 400 EC	175 mL (70 mL)	Apply when egg masses begin to hatch but no later than when 1st feeding occurs on foliage. For 2nd brood in late planting, apply before tassels show. Use a minimum 300-500 L water/ha for ground application and 11-22 L/ha for aerial application. Re-entry period when foliage dries. Maximum 3 applications/yr. Up to 2 applications/season by air. 5 days to harvest.
	cyhalothrin-lambda	Matador 120 E	83-187 mL (34-76 mL)	Ground and aerial application. Spray no later than 1st appearance of feeding. Spray no later than 14 days before silage harvest. Maximum 3 applications/season, 2 may be by air.
		Silencer 120 EC	83 mL (34 mL)	
	<i>Bacillus thuringiensis</i>	Dipel 2X DF	0.56-1.12 kg (0.22-0.45 kg)	Good option for organically grown corn. Apply when pinhole feeding is observed in at least 5% of the plants. Repeat at 7-day intervals. Only effective against small larvae and must be applied before larvae begin stalk boring.
	carbaryl	Sevin XLR Plus	2.5-4.0 L (1.0-1.6 L)	For larvae in whorls and foliage, treat entire plant. Repeat as necessary. For silks and ears, apply in 2-4-day intervals when silks first appear. 1 day to harvest. Follow label precautions applying to honeybees.

CORN INSECTS

Table 1-2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
ARMYWORM (TRUE – <i>Pseudaletia unipuncta</i>, FALL – <i>Spodoptera frugiperda</i>)				
Five to six larvae in an area 30 x 30 cm warrant chemical control. Treat if larvae <2.0 cm long and threshold has been exceeded. If larvae have white eggs attached to them, they are parasitized and may not need treatment. If larvae are 2.0 cm or larger, chemical control will not work well and is not recommended.	carbaryl	Sevin XLR Plus	2.5–4.0 L (1.0–1.6 L)	For larvae in whorls and foliage, treat entire plant. Repeat as necessary. For silks and ears, apply in 2–4-day intervals. 1 day to harvest. Follow label precautions regarding honeybees.
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	Ground and aerial application. Spray no later than 1st appearance of feeding. Spray no later than 14 days before silage harvest. Maximum 3 applications/season, 2 may be by air.
		Silencer 120 EC	83 mL (34 mL)	Fall armyworm only. Ground and aerial application. Spray no later than 1st appearance of feeding. Spray no later than 14 days before silage harvest. Maximum 3 applications/season, 2 may be by air.
CORN EARWORM (CEW) (<i>Helicoverpa zea</i>)				
Insecticides have generally not provided economic control of CEW in field corn. There may be some value in treating seed corn to maintain kernel quality.	cyhalothrin-lambda	Matador 120 E	83–187 mL (34–76 mL)	Spray no later than 1st appearance of feeding. Spray no later than 14 days before silage harvest. Maximum 3 applications/season, 2 may be by air.
		Silencer 120 EC	83 mL (34 mL)	
	cypermethrin	Ripcord 400 EC	175 mL (70 mL)	Ground and aerial application. Ensure good coverage of ears and silks. Use minimum 300–500 L/ha of water for ground application and 11–22 L/ha for aerial application. 5 days to harvest. Maximum 3 applications/yr, 2 may be by air.
CORN FLEA BEETLE (<i>Chaetocnema pulicaria</i>)				
Seed Treatment			per 80,000 kernels	
Flea beetles are a vector of Stewart's bacterial wilt. It is uneconomical to spray corn with insecticides to protect against Stewart's wilt except in seed corn with highly susceptible inbreds.	clothianidin	Poncho 250	33.3 mL	For use in commercial seed treaters only. Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
	imidacloprid	Gaucho 480 FL	100 mL	For seed corn only. Ensure good coverage. For use in commercial seed treaters only. Seed-applied insecticides can affect seed drop and final plant stands. Use talc or graphite according to planter recommendations to ensure accuracy.
	thiamethoxam	Cruiser 5 FS	16.7–33.3 mL	For use in commercial seed treaters only. Do not graze or feed livestock on treated areas for 45 days after planting.

CORN INSECTS

Table 1-2. Chemical Control Options for Insects in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
POTATO STEM BORER (<i>Hydraecia micacea</i>)				
No insecticides are recommended or registered.				
SLUGS (Various species)				
Usually not an economic pest because growing point is not affected. Chemical control is not recommended.				
CORN LEAF APHID (<i>Rhopalosiphum maidis</i>)			per ha (per acre)	
Aphids are rarely a problem in corn in Ontario. Spray only if populations exceed 400 aphids per plant on average.	endosulfan	Thiodan 4 EC	2.75 L (1.1 L)	Ground application only. Maximum 2 applications/season. 50 days to harvest.
		Thionex EC	2.75 L (1.1 L)	
SAP BEETLES (<i>Glischrochilus quadrisignatus</i>)				
Not an economic pest but can carry <i>Fusarium</i> . Chemical control is not recommended.				

CORN INSECTS AND DISEASES

Table 1-3. Corn (Field and Seed) Seed and Soil-Applied Fungicide Recommendations

Active Ingredients	Product	Formulation	Corn Diseases				
			Fusarium Seedling Blight	Rhizoctonia Damping-Off	Pythium Damping-Off	Aspergillus Seed Rot	Penicillium Seed Rot
Insect and Disease Control							
Untreated Seed							
diazinon + captan	Agrox B-2	P (DB)	+	—	—	+	+
Seed Pre-Treated With Fungicide							
diazinon + captan	Agrox CD	P (DB)	For insect control only. Disease control via fungicide pretreatment.				
Disease Control							
azoxystrobin	Dynasty 100 FS	F	—	+	+	—	—
captan	Captan Flowable	F	+	—	—	+	+
carbathiin + thiram	Vitaflo-280	F	+	+	—	—	—
fludioxonil	Maxim 480 FS	F	+	+	—	+	+
metalaxyl	Allegiance FL	F	—	—	+	—	—
	Apron FL	F	—	—	+	—	—
metalaxyl-M	Apron XL	LS	—	—	+	—	—
DB = Drill Box Application F = Flowable LS = Liquid Suspension P= Powder							
+ = Recommended for disease listed — = NOT recommended							

CORN DISEASES

Table 1–4. Chemical Control Options for Diseases in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
<p>It is recommended that all seed corn be treated with a fungicide seed treatment to prevent early-season preemergence and postemergent damping-off problems. This will help reduce seed decay and seedling blights. Corn seedling diseases are prevalent under cool wet conditions that keep the soil temperatures below 13°C (55°F). Low-lying or poorly drained areas of the field are often the first to show disease problems. Seed rots and seedling blights are more severe in no-till or reduced-tillage fields since heavy residue will keep soil temperatures cooler and wetter longer than conventional fields. Damping-off will occur in conventional fields when the crop is planted early into conditions that favour disease development or when environmental conditions cause the corn seed to sit in the ground for a prolonged period of time. Other factors that delay germination and emergence, such as compaction, crusting, deep planting, etc., can also result in a poor stand. Plant vigour is often reduced in those plants that do survive.</p>				
DAMPING-OFF PYTHIUM (<i>Pythium</i> spp.)				
Seed Treatment			per 100 kg seed	
<p>Can occur on all soil types but losses are greatest in cold, wet clay soils. Minimize soil compaction and remove excess moisture through increased drainage. Plant when soil temperatures are above 13°C (55°F). Treat seed with metalaxyl or metalaxyl-M. No known resistance but some degree of tolerance available in hybrids. Rotation has limited effect.</p>	metalaxyl-M	Apron XL LS	20–40 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or cut for forage within 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Allegiance FL	46–110 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.
		Apron FL	46–110 mL	
	azoxystrobin	Dynasty 100 FS	10 mL	For use in commercial seed treatment plants only. Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Must be used in combination with Maxim XL.
RHIZOCTONIA (<i>Rhizoctonia solani</i>)				
Seed Treatment			per 100 kg seed	
<p>Can occur on all soil types. No known resistance. Remove excess moisture. Plant when soil temperatures are above 13°C (55°F).</p>	fludioxonil	Maxim 480 FS	5.2–10.4 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or cut for forage within 4 weeks after planting. 30 days to harvest.
	carbathiin + thiram	Vitaflo 280	280 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	azoxystrobin	Dynasty 100 FS	10 mL	For use in commercial seed treatment plants only. Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Must be used in combination with Maxim XL.

CORN DISEASES

Table 1-4. Chemical Control Options for Diseases in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
FUSARIUM SEEDLING BLIGHT (<i>F. culmorum</i> , <i>F. graminearum</i> and <i>F. avenaceum</i>)				
Seed Treatment			per 100 kg seed	
Some level of resistance or tolerance available in hybrids. Rotate with other crops. Tillage has little effect. Treat seed with fungicide and reduce early-season stresses. Plant when soil temperatures are above 13 C (55 F).	fludioxonil	Maxim 480 FS	5.2–10.4 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or cut for forage within 4 weeks after planting. 30 days to harvest.
	carbathiin + thiram	Vitaflo 280	280 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	captan	Captan Flowable	200 mL	Mix with the amount of water required for the slurry treater equipment to be used.
ASPERGILLUS (<i>Aspergillus</i> spp.) and PENICILLIUM (<i>Penicillium oxalicum</i>) SEED ROT				
Seed Treatment			per 100 kg seed	
Penicillium seedling blight favours high temperatures and is found only until the nodal roots develop. Infected roots may appear blue-green. Aspergillus seed rot is not generally a problem in Ontario.	fludioxonil	Maxim 480 FS	5.2–10.4 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or cut for forage within 4 weeks after planting. 30 days to harvest.
RUST (<i>Puccinia sorghi</i>)			per ha (per acre)	
Rust is generally not a problem in Ontario except when infection begins early in the season. Field corn has good resistance when compared to seed corn, sweet corn and specialty corn hybrids. As a result, foliar fungicides in field corn are not needed unless significant disease appears before corn tassels. Humid, cool conditions favour the disease.	azoxystrobin	Quadris	453 mL (183 mL)	Ground application only. Apply prior to disease development. Second application may be made 7–14 days later. Maximum 2 applications/season. 7 days to harvest.
	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground and aerial application. Use a minimum water volume of 100 L/ha. For optimal disease control, begin applications prior to disease development. Do not graze treated crop within 6 days of last application. 7 days to harvest. Maximum 2 applications/yr.
	azoxystrobin + propiconazole	Quilt	0.75–1.0 L (305–406 mL)	Ground and aerial application. Apply when disease first appears, followed by a second application 14 days after the first, if environmental conditions are favourable for disease development. Do not apply to field corn or field corn grown for seed after brown silk. 30 days to harvest for forage. 14 days to harvest for sweet corn. Maximum 2 applications/season.
	propiconazole	Tilt 250 E Bumper 418 EC	500 mL (200 mL) 300 mL (121 mL)	Ground and aerial application. Apply when rust pustules first appear. Can be tank-mixed with Ripcord or Matador insecticide for insect and disease control. Under severe disease pressure, a second application 14 days later may be necessary. Only in seed corn, under severe disease pressure, can a third application, 14 days later be made. 14 days to harvest.

CORN DISEASES

Table 1–4. Chemical Control Options for Diseases in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
NORTHERN CORN LEAF BLIGHT (<i>Setosphaeria turcica</i>)				
Incidence of this disease is on the rise in Ontario. Not generally a problem in field corn, since good resistance is available. Seed corn may need protection. Crop rotation and tillage will reduce inoculum levels in surface residues. In reduced tillage systems, rotation and resistance are necessary. Chemical control not usually economical in field corn.	azoxystrobin + propiconazole	Quilt	0.75–1.0 L (305–406 mL)	Ground and aerial application. Apply when disease first appears, followed by a second application 14 days after the first, if environmental conditions are favourable for disease development. Do not apply to field corn and field corn grown for seed after brown silk. 30 days to harvest for forage. 14 days to harvest for sweet corn. Maximum 2 applications/season.
	propiconazole	Tilt 250 E	250–500 mL (100–200 mL)	Ground and aerial application. Apply when disease first appears. Can be tank-mixed with Ripcord or Matador insecticide for insect and disease control. 14 days to harvest.
		Bumper 418 EC	150–300 mL (60–121 mL)	
HELMINTHOSPORIUM LEAF SPOT (<i>Cochliobolus carbonum</i>)				
Not generally a problem in Ontario since resistance hybrids are available. Crop rotation and tillage will reduce inoculum levels in surface residues. In reduced tillage systems, rotation and resistance are necessary. Chemical control not usually economical in field corn.	propiconazole	Tilt 250 E	250–500 mL (100–200 mL)	Ground and aerial application. Apply when disease first appears. Can be tank-mixed with Ripcord or Matador insecticide for insect and disease control. 14 days to harvest.
		Bumper 418 EC	150–300 mL (60–121 mL)	
EYE SPOT (<i>Aureobasidium zeae</i>)			per ha (per acre)	
Many resistant or tolerant commercial hybrids are available. Crop rotation and tillage will reduce inoculum levels in surface residues. In reduced tillage systems, rotation and resistance are necessary. Chemical control usually not economical in field corn but may be necessary if a very susceptible seed corn inbred is used.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground and aerial application. Use a minimum water volume of 100 L/ ha. For optimal disease control, begin applications prior to disease development. Do not graze treated crop within 6 days of last application. 7 days to harvest. Maximum 2 applications/yr.
	azoxystrobin + propiconazole	Quilt	0.75–1.0 L (305–406 mL)	Ground and aerial application. Apply when disease first appears, followed by a second application 14 days after the first, if environmental conditions are favourable for disease development. Do not apply to field corn and field corn grown for seed after brown silk. 30 days to harvest for forage. 14 days to harvest for sweet corn. Maximum 2 applications/season.
	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply when disease first appears. Can be tank mixed with Ripcord or Matador insecticide for insect and disease control. 14 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	

CORN DISEASES

Table 1-4. Chemical Control Options for Diseases in Field and Seed Corn

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
GREY LEAF SPOT (<i>Cercospora zeae-maydis</i>)			per ha (per acre)	
This disease is becoming more common in Southwestern Ontario. Some hybrids are tolerant/resistant to the disease. Crop rotation and tillage will reduce inoculum levels in surface residues. In reduced tillage systems, rotation and resistance are necessary. Chemical control usually not economical in field corn.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground and aerial application. Use a minimum water volume of 100 L/ ha. For optimal disease control, begin applications prior to disease development. Do not graze treated crop within 6 days of last application. 7 days to harvest. Maximum 2 applications/yr.
	azoxystrobin + propiconazole	Quilt	0.75–1.0 L (305–406 mL)	Ground and aerial application. Apply when disease first appears followed by a second application 14 days after the first, if environmental conditions are favourable for disease development. Do not apply to field corn and field corn grown for seed after brown silk. 30 days to harvest for forage. 14 days to harvest for sweet corn. Maximum 2 applications/season.
	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply when disease first appears. Can be tank-mixed with Ripcord or Matador insecticide for insect and disease control. 14 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
SOUTHERN CORN LEAF BLIGHT (<i>Cochliobolus heterostrophus</i>)			per ha (per acre)	
	azoxystrobin + propiconazole	Quilt	0.75–1.0 L (305–406 mL)	Ground and aerial application. Apply when disease first appears, followed by a second application 14 days after the first, if environmental conditions are favourable for disease development. Do not apply to field corn and field corn grown for seed after brown silk. 30 days to harvest for forage. 14 days to harvest for sweet corn. Maximum 2 applications/season.
	propiconazole	Tilt 250 E	250–500 mL (100–200 mL)	Ground and aerial application. Apply when disease first appears. Can be tank mixed with Ripcord or Matador insecticide for insect and disease control. 14 days to harvest.
		Bumper 418 EC	150–300 mL (60–121 mL)	

2. Soybeans

SOYBEAN INSECTS

Table 2-1. Chemical Control Options for Insects in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEEDCORN MAGGOT (<i>Delia platura</i>)				
Seed Treatment	per 100 kg seed			
Consider insecticide seed treatments in early-planted fields where large amounts of manure, green manure or residue have been recently incorporated or when cool backward emergence conditions are expected. Expect only 60%–70% control with seed treatments applied on-farm.	For all seed treatments use full rate and ensure good coverage of seed.			
	diazinon + captan	Agrox B-2	340 g	Available as 2-kg container that will treat 625 kg of soybean seed. Do not use on seed already treated with an insecticide. Seed within 1 month of treatment.
		Agrox CD	200 g	Available as a 600-g container that will treat 300 kg of soybean seed. Use this product only on seed previously treated with captan or thiram.
	thiamethoxam	Cruiser S FS	50–83 mL	For use in commercial seed treaters only. Use higher rate when insect populations are expected to be high. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	For commercial application only. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
SLUGS (Various species)				
No chemical control available. Slugs often avoid contact by feeding below ground, and rainfall easily washes the material from the leaves. Removing crop residue will help expose slugs to the elements. Tillage will also disturb their habitat and expose them to predators.				
See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for rotation and tillage recommendations.				

SOYBEAN INSECTS

Table 2-1. Chemical Control Options for Insects in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SOYBEAN APHID (<i>Aphis glycines</i>)				
Seed Treatment			per 100 kg seed	
Foliar treatment at threshold is the recommended method of control. However, seed treatments for the control of other soil insect pests may provide early-season protection (up to 40 days after planting) from early infestations of soybean aphids.	thiamethoxam	Cruiser 5 FS	83 mL	For use in commercial seed treaters only. Provides only early-season protection against soybean aphids and will not protect crop against typical mid-to-late-season aphid infestations.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	For commercial application only. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. Provides early-season protection (up to 60 days after planting). Will not protect crop against typical mid-to-late season aphid infestations.
Foliar Treatment			per ha (per acre)	
Foliar treatment is the recommended method of control for soybean aphids. Aphid infestations are more likely to cause yield reduction if the plants are already suffering from drought conditions or another stress factor. Scout fields frequently. Apply foliar insecticide when threshold of "250 aphids per plant with increasing populations" has been reached in the R1-R5 stage of soybeans. If aphid populations do not appear to be on the increase above 250 per plant, do not apply insecticide, as it will kill off the beneficial insects that are keeping the aphid population in check. Aphids are then likely to increase quickly in the absence of their predators and could easily reach threshold.	cyhalothrin-lambda	Matador 120 E	83-33 mL (34-94 mL)	Ground and aerial application. For best results, apply during the early morning, before temperatures rise, and during the evening, past the heat of the day. Use higher rate when conditions favour rapidly increasing populations or when crop canopies are dense, resulting in poor spray coverage. Select nozzle size, type and pressure to produce a medium spray. Use 100-200 L water/ha. Maximum 3 applications/yr. 21 days to harvest. Do not re-enter treated areas until 24 hr of treatment.
		Silencer 120 EC	83 mL (34 mL)	Ground application only. For best results, apply during the early morning, before temperatures rise, and during the evening, past the heat of the day. 21 days to harvest. Maximum 3 applications/yr. Do not graze or harvest treated forage, straw or hay for livestock feed.
For further information on scouting techniques, OMAFRA weekly scouting results, thresholds and management options, see OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , as well as the Ontario Soybean Growers website at www.soybean.on.ca .	dimethoate	Cygon 480	1 L (400 mL)	Use high volume, high pressure and ensure good coverage. Do not feed or allow livestock to graze on treated forage.
		Lagon 480 EC	1 L (400 mL)	Do not apply within 30 days of harvest.

SOYBEAN INSECTS

Table 2-1. Chemical Control Options for Insects in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
TWO-SPOTTED SPIDERMITES (<i>Tetranychus urticae</i>)				
Scout fields around the first week of July. Infestations usually move in from edge of field as hot spots. Spot spray when populations average 4 mites per leaf. Do not use a pyrethroid insecticide (e.g., Matador) for the control of spidermites, as it will kill the beneficial mites and cause the spidermite populations to increase.	dimethoate	Cygon 4 E	1 L (400 mL)	Do not feed or allow livestock to graze treated forage. Maximum 2 applications/season. 30 days to harvest.
		Lagon 480 EC	1 L (400 mL)	
POTATO LEAFHOPPER (<i>Empoasca fabae</i>)				
Potato leafhoppers are controlled in soybeans by plant resistance via leaf pubescence. Problems are rare in soybeans in Ontario. Food grade soybeans may need protection.	dimethoate	Cygon 4 E	0.7–1 L (280–400 mL)	Do not feed or allow livestock to graze treated forage. Maximum 3 applications/season. 30 days to harvest.
		Lagon 480 EC	0.7–1 L (280–400 mL)	
BEAN LEAF BEETLE (<i>Certoma trifurcata</i>)				
Seed Treatment			per 100 kg seed	
Seed treatment recommended only for those fields with a history of early-season infestation from overwintering adults. Fields in Essex and Kent Counties in particular tend to experience injury to the seedling crop from early infestations of beetles.	thiamethoxam	Cruiser 5 FS	83 mL	For use in commercial seed treaters only. To reduce early-season defoliation.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	For commercial application only. To reduce early-season defoliation. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
Foliar Treatment			per ha (per acre)	
For protection from overwintering adults, in areas with history of injury, consider using insecticide seed treatment for early-planted soybeans.	cyhalothrin-lambda	Matador 120 E	83–233 mL (34–94 mL)	Ground and aerial application. For best results, apply during the early morning, before temperatures rise, and during the evening, past the heat of the day. Use 100–200 L water/ha. Use higher rate for higher pest populations. Maximum 3 applications/yr. 21 days to harvest. Do not re-enter treated areas until 24 hr of treatment.
Rarely do bean leaf beetle populations cause enough defoliation to require an insecticide application in Ontario. Defoliation thresholds during the R1–R5 stage are listed in the OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> .		Silencer 120 EC	83 mL (34 mL)	
Food-grade and seed soybeans may require protection, especially during the later R5 and R6 pod stages to reduce pod disease development caused by beetle feeding. If 10% of pods have feeding damage, insecticide may be necessary. Pay attention to preharvest intervals when spraying during the R6 stage of soybeans.	dimethoate	Cygon 4 E	0.7–1 L (280–400 mL)	Do not feed or allow livestock to graze treated forage. Maximum 3 applications/season. 30 days to harvest.
		Lagon 480 EC	0.7–1 L (280–400 mL)	

SOYBEAN DISEASES

Table 2-2. Soybean Seed and Soil-Applied Fungicide Recommendations

Active Ingredients	Product	Formulation	Soybean Diseases				
			Phytophthora	Pythium Damping-Off	Phomopsis Seed Mould	Rhizoctonia Damping-Off	Fusarium Seedling Blight
Insect and Disease Control							
Untreated Seed							
diazinon + captan	Agrox B-2	P (DB)	—	—	+	—	+
thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	F	+	+	+	+	+
Seed Pretreated With Fungicide							
diazinon + captan	Agrox CD	P (DB)	For insect control only. Disease control via fungicide pretreatment.				
Disease Control							
captan	Captan	F	—	—	+	—	+
carbathiin + thiram	Anchor	F (DB)	—	—	+	+	+
	Vitaflo-280	F	—	—	+	+	+
fludioxonil	Maxim 480 FS	F	—	—	+	+	+
fludioxonil + metalaxyl-M	Apron Maxx RTA	F	+	+	+	+	+
	Apron Maxx RFC	F	+	+	+	+	+
metalaxyl	Allegiance FL	F	+	+	—	—	—
	Apron FL	F	+	+	—	—	—
metalaxyl-M	Apron XL	LS	+	+	—	—	—
DB = Drill Box Application F = Flowable P = Powder LS = Liquid Suspension							
+ = Recommended for disease listed — = NOT recommended							

SOYBEAN DISEASES

Table 2-3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SOYBEAN CYST NEMATODE (<i>Heterodera glycines</i>)				
Soybean cyst nematode (SCN) is often confused with other common problems such as nutrient deficiencies, herbicide injury, soil compaction, drought, flooding or root rots. By the time above-ground symptoms from SCN feeding become noticeable, most fields have lost 25%–30% yield potential to the nematode. Early detection through scouting and soil testing is critical. If you suspect SCN, plants should be carefully dug (not pulled) and soil gently removed from the roots. Cysts are white to yellow and about the size of a pinhead. Rotating non-host crops such as corn, wheat, alfalfa or vegetable crops such as tomatoes, with resistant varieties, will lower SCN populations and improve yields on SCN-infested fields. In addition, rotation of SCN-resistant varieties is recommended to reduce shifts in the nematode population.				
PHYTOPHTHORA ROOT ROT (<i>Phytophthora sojae</i>)				
Seed Treatment			per 100 kg seed	
Select soybean varieties that have both specific resistance (Rps genes such as IK and IC) and good partial resistance (tolerance) to all races of <i>Phytophthora</i> . Consult with your seed company for variety profiles. Primarily controlled through resistant varieties. Losses are greatest in cold, wet, clay soils. Minimize soil compaction and remove excess moisture through increased drainage. A small amount of tillage will help warm soil and increase surface drainage. Rotate with corn and wheat. Plant when soil temperatures are above 13°C (55°F). Treat seed with metalaxyl or metalaxyl-M (higher rate).	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Provides early-season protection for tolerant varieties. If target fields have a history of high <i>Phytophthora</i> pressure, or if susceptible varieties are to be treated, tank-mix with 31 mL per 100 kg seed of Apron XL LS. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For commercial and on-farm application. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. Provides early-season protection against phytophthora root rot for tolerant varieties of soybeans. If target fields have a history of high pressure or if susceptible varieties are to be treated, tank-mix with 31 mL of Apron XL LS per 100 kg seed.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	For commercial application only. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. Provides early-season protection against phytophthora root rot for tolerant varieties of soybeans. If target fields have a history of high pressure or if susceptible varieties are to be treated, tank-mix with 31 mL of Apron XL LS per 100 kg of seed.
	metalaxyl-M	Apron XL-LS	40 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Allegiance FL Apron FL	46–93 mL 46–93 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.

SOYBEAN DISEASES

Table 2-3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
PHOMOPSIS SEED MOULD (<i>Phomopsis longicolla</i>)				
Seed Treatment			per 100 kg seed	
Most severe when cool, wet conditions delay harvest. Some varieties are more susceptible than others. Fungicide seed treatments will improve the germination of low to moderately infected seed. Do not plant severely infected seed. Plant good-quality seed with a germination rate of at least 80%–90%. Rotate with non-host crops such as corn and wheat, remove excess surface residue and harvest as early as possible.	carbathiin + thiram	Anchor	600 mL	Drill box application. Ensure uniform coverage on seed. Do not apply Anchor through commercial seed-treating equipment or through an auger, as excessive seed wetness may result. Do not graze or feed livestock on treated areas for 4 weeks after planting.
		Vitaflo 280	260 mL	Do not store treated soybean seed. May be applied through commercial seed treatment equipment or auger. Ensure uniform coverage.
	captan	Captan Flowable	280 mL	Mix with the amount of water required for the slurry treater equipment to be used.
	fludioxonil	Maxim 480 FS	5.2–10.4 mL	For commercial application only. Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze treated crops or cut for forage within 30 days of planting.
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity or mist-type seed treatment equipment. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For commercial and on-farm application. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	For commercial application only. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.

SOYBEAN DISEASES

Table 2-3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
RHIZOCTONIA DAMPING-OFF (<i>Rhizoctonia solani</i>)				
Seed Treatment			per 100 kg seed	
Can occur on all soil types and environmental conditions. Disease losses are greatest when a dry spring is followed by wet conditions. Few management options exist since no resistant or tolerant varieties are available. Seed treatment and crop rotation with corn and small grains can help minimize the disease.	fludioxonil	Maxim 480 FS	5.2–10.4 mL	For commercial application only. Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting.
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For commercial and on-farm application. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	For commercial application only. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	carbathiin + thiram	Anchor	600 mL	Drill box application. Ensure uniform coverage on seed. Do not apply Anchor through commercial seed-treating equipment or through an auger, as excessive seed wetness may result. Do not graze or feed livestock on treated areas for 4 weeks after planting.
		Vitaflo 280	260 mL	Do not store treated soybean seed. May be applied through commercial seed treatment equipment or auger. Ensure uniform coverage.

SOYBEAN DISEASES

Table 2–3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
PYTHIUM DAMPING-OFF (<i>Pythium</i> spp.)				
Seed Treatment			per 100 kg seed	
Can occur on all soil types but losses are greatest in cold, wet, clay soils. Minimize soil compaction and remove excess moisture through increased drainage. Plant when soil temperatures are above 13°C (55°F). Treat seed with metalaxyl or metalaxyl-M. No known resistance but some degree of tolerance available in cultivars. Rotation has limited effect. <i>Pythium</i> control less affected by rate.	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For commercial and on-farm application. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	For commercial application only. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	metalaxyl	Allegiance FL	46–93 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.
		Apron FL	46–93 mL	
	metalaxyl-M	Apron XL LS	20–40 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.

SOYBEAN DISEASES

Table 2-3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
FUSARIUM SEEDLING BLIGHT (<i>Fusarium oxysporum</i> or <i>Fusarium solani</i>)				
Seed Treatment Cool, wet spring conditions favour infection. Resistant varieties not available. Minimize soil compaction and remove excess moisture through increased drainage. A small amount of tillage will help warm soil and increase surface drainage. Rotate with corn and wheat. Plant high-quality seed when soil temperatures are above 13°C (55°F). Fungicide seed treatment recommended. Mounding or ridging soil at the base of the plants produces adventitious roots that can minimize losses.	fludioxynil	Maxim 480 FS	5.2–10.4 mL	For commercial application only. Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting.
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For commercial and on-farm application. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamectoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans Beans	195 mL	For commercial application only. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting.
	carbathiin + thiram	Anchor	600 mL	Drill box application. Ensure uniform coverage on seed. Do not apply Anchor through commercial seed-treating equipment or through an auger, as excessive seed wetness may result. Do not graze or feed livestock on treated areas for 4 weeks after planting.
		VitaFlo 280	260 mL	Do not store treated soybean seed. May be applied through commercial seed-treatment equipment or auger. Ensure uniform coverage.
	diazinon + captan	Agrox B-2	320 g	Available as a 2-kg container that will treat 625 kg of soybean seed. Use full rate and ensure good coverage of seed. Seed within 1 month of treatment. Do not use on seed already treated with an insecticide.
	captan	Captan Flowable	280 mL	Mix with the amount of water required for the slurry treater equipment to be used.

SOYBEAN DISEASES

Table 2-3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
WHITE MOULD (<i>Sclerotinia sclerotiorum</i>)				
Foliar Treatment				
<p>White mould is a sporadic disease that thrives under cool, wet conditions during flowering or near harvest. Fields at risk have a history of white mould, good leaf growth and high populations and more than 48 hr of continuous wetness and air temperatures between 15°C and 20°C (day and night average temperatures).</p> <p>In fields with a history of white mould, use non-host crops and avoid growing other host crops such as canola, edible beans, buckwheat and sunflowers for 2-3 years. plant a tolerant variety although none are resistant (immune), plant a variety with good lodging resistance and keep sclerotia on the surface through conservation tillage practices.</p>				No registered products available at this time.

SOYBEAN DISEASES

Table 2-3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
ASIAN SOYBEAN RUST (<i>Phakopsora pachyrhizi</i>)				
Foliar Treatment			per ha (per acre)	
<p>Asian soybean rust is a new invasive fungal disease of soybean in North America. Scouting and early detection are critical to managing this disease. The early stages of the disease can be confused with other common foliar diseases such as septoria brown spot, bacterial pustule, downy mildew, frog-eye leaf spot and bacterial blight.</p> <p>Numerous factors such as crop stage (R1–R6), yield potential, disease risk or presence are critical components of the fungicide decision process. Strobilurin fungicides such as Headline or Quadris are protective products that stop spore germination and penetration into the soybean leaf. The strobilurins have no effect on the fungus once inside the leaf. Since the strobilurin group of fungicides have no curative activity, do not make solo applications of a strobilurin if any rust is present. The triazole fungicides such as Tilt and Folicur have varying protective abilities and are usually considered “early post-infection” fungicides. The post-infection or curative abilities are limited, and the fungicides may not perform well if 5%–10% disease is present in the lower crop canopy. Combination products containing both a strobilurin and triazole fungicide such as Quilt have preventive (pre-infection) and curative (post-infection) properties.</p> <p>Yield loss is very likely once rust can be found in the mid-crop canopy. For these reasons, scouting, fungicide selection, timing and application are critical to successful management of soybean rust.</p> <p>For further information on scouting techniques, sentinel plots, thresholds, management options and emergency use registrations, see OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i>, as well as the Ontario Soybean Growers website at www.soybean.on.ca.</p>	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground and aerial application. Maximum 2 applications/yr. Classified as a strobilurin fungicide; use in a preventive fungicide program (pre-infection). See label for resistance management strategy. 21 days to harvest interval.
	azoxystrobin	Quadris	500 mL (200 mL)	Ground and aerial application. Maximum 2 applications/yr. Classified as a strobilurin fungicide; use in a preventive fungicide program (pre-infection). See label for resistance management strategy. 15 days to harvest interval.
	propiconazole	Tilt 250 E	500–750 mL (200–300 mL)	Ground and aerial application. Make first application at the first sign of disease, followed by a second application 14 days after the first application if environmental conditions are favourable for disease development. Maximum 2 applications/yr. See label for resistance management strategy. 30 days to harvest interval.
	azoxystrobin + propiconazole	Quilt	1.0–1.5 L (400–600 mL)	Ground and aerial application. Make the first application at the first sign of disease. Apply the high rate only under conditions of high disease pressures. A second application at a 14-day interval may be needed if conditions persist. Good spray coverage and canopy penetration are important for best results. Apply in a minimum of 45 L of water per hectare. Maximum 2 applications/yr. See label for resistance management strategy. 30 days to harvest interval.

SOYBEAN DISEASES

Table 2-3. Chemical Control Options for Diseases in Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
FROG-EYE LEAF SPOT (<i>Cercospora sojina</i>)				
Foliar Treatment Economic impact is minimal. Frog-eye leaf spot occurs under hot, humid conditions particularly on very susceptible varieties. The disease is most frequent in the extreme southwest counties.			per ha (per acre)	
	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground and aerial application. Maximum 2 applications/year. Make first application at the first sign of disease followed by the second application 14 days after, if environmental conditions are favourable for disease development. 21 days to harvest interval.
	propiconazole	Bumper 418 EC	300–455 mL (121–184 mL)	For soybeans grown for seed only. Ground application only. Apply when disease first appears. Under severe disease pressure, make a second application 14 days after. 50 days to harvest interval. Do not use soybean seed for human or animal consumption.
		Tilt 250 E	500–760 mL (200–308 mL)	For soybeans grown for seed only. Ground application only. Apply when disease first appears. Under severe disease pressure, make a second application 14 days after. 30 days to harvest interval. Soybean seed should not be used for human or animal consumption.

3. Forages

FORAGE CROP INSECTS

Table 3-1. Chemical Control Options for Insects in Forage Crops

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
ALFALFA SNOUT BEETLE (<i>Otiorhynchus ligustici</i>)				
No chemical control available. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for management information.				
ALFALFA WEEVIL (<i>Hypera postica</i> Gyll)				
			per ha (per acre)	
First Cut: If 40% of the stems have feeding damage in the tips, cut and remove from fields as soon as possible. If this level of damage occurs a week or more before optimum cutting time, spray is necessary. Second Cut: If damage was serious on first cut, feeding may continue. Check early regrowth carefully. Natural enemies are generally highly effective at controlling this pest. For the safety of these natural enemies, chemical control is not recommended unless pest population exceeds the action threshold. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for more information on action thresholds.	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	Alfalfa only. Ground and aerial application. Apply when larvae are small and populations are high. Maximum 3 applications/yr. 1 may be by air. Allow 7 days between treatments. Do not apply within 3 days of livestock grazing. Alfalfa seed from treated crop is not to be used for production of alfalfa sprouts for human consumption. 24-hr re-entry period.
		Silencer 120 EC	83 mL (34 mL)	Alfalfa only. Ground application only. Apply when larvae are small and populations are high. Maximum 3 applications/yr. 1 may be by air. Allow 7 days between treatments. Do not apply within 3 days of livestock grazing. Alfalfa seed from treated crop is not to be used for production of alfalfa sprouts for human consumption. 24-hr re-entry period.
	phosmet	Imidan 50 WP	2.25 kg (900 g)	Alfalfa only. Ground application only. Do not apply during bloom. Only 1 application per cutting. 7 days to cutting or grazing.
POTATO LEAFHOPPER (<i>Empoasca fabae</i>)				
			per ha (per acre)	
Leafhoppers are most severe in new seedlings and in regrowth under hot dry weather. Some resistant varieties having glandular hairs on the leaves and stems have been found to be effective. Use chemical control only if leafhoppers exceed the threshold, as insecticides will also kill effective natural enemies of alfalfa weevil. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for threshold charts.	dimethoate	Cygon 480 EC	425 mL (170 mL)	Alfalfa, forage and pasture. Ground and aerial application. Do not apply during bloom. 2 days to harvest and grazing. Maximum 2 applications/season.
		Lagon 480 EC	425 mL (170 mL)	
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	Alfalfa only. Ground and aerial application. Apply when larvae are small and populations are high. Maximum 3 applications/yr. 1 may be by air. Allow 7 days between treatments. Do not apply within 3 days of livestock grazing. Alfalfa seed from treated crop is not to be used for production of alfalfa sprouts for human consumption. 24-hr re-entry period.
		Silencer 120 EC	83 mL (34 mL)	Alfalfa only. Ground application only. Apply when larvae are small and populations are high. Maximum 3 applications/yr. 1 may be by air. Allow 7 days between treatments. Do not apply within 3 days of livestock grazing. Alfalfa seed from treated crop is not to be used for production of alfalfa sprouts for human consumption. 24-hr re-entry period.

FORAGE CROP INSECTS

Table 3-1. Chemical Control Options for Insects in Forage Crops

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
EUROPEAN SKIPPER (<i>Thymelicus lineola</i>)			per ha (per acre)	
If 6–8 caterpillars in a 30-cm x 30-cm area are found as early as the brown-headed stage, treat the field or the infested area. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for scouting procedures.	<i>Bacillus thuringiensis</i> (Bt)	Dipel 2X DF	140–275 g (60–115 g)	Timothy only. 0 days to cutting or grazing.
		Thuricide HPC	2.25 L (900 mL)	
GRASSHOPPERS (Various species)			per ha (per acre)	
Begin scouting in late June when grasshoppers are still young. Spraying insecticides on alfalfa will also kill the natural enemies of alfalfa weevil and lygus bugs.	cyhalothrin-lambda	Matador 120 E	63–83 mL (26–34 mL)	Alfalfa only. Ground and aerial application. Apply when nymphs are small and populations are high. Maximum 3 applications/yr. 1 may be by air. Allow 7 days between treatments. Do not apply within 3 days of livestock grazing. Alfalfa seed from treated crop is not to be used for production of alfalfa sprouts for human consumption. 24-hr re-entry period.
		Silencer 120 EC		
		malathion	Malathion 500 EC	2.25–2.75 L (0.9–1.1 L)
ALFALFA BLOTCH LEAFMINER (<i>Agromyza frontella</i>)			per ha (per acre)	
Natural enemies are highly effective at controlling this pest. For the safety of these natural enemies, chemical control is not recommended unless pest population exceeds the action threshold. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for more information.	dimethoate	Cygon 480 E	550 mL (220 mL)	Alfalfa only. Ground and aerial application. Do not apply during bloom. Use at least 200 L/ha of water for ground application. Maximum 2 applications/season. 2 days to cutting or grazing.
		Lagon 480 E	550 mL (220 mL)	
		phosmet	Imidan 50 WP	2.25 kg (900 g)
ARMYWORM (TRUE – <i>Pseudaletia unipuncta</i>, FALL – <i>Spodoptera frugiperda</i>)			per ha (per acre)	
If 50% of the plants are infested with unparasitized larvae smaller than 2.5 cm (1 in.), using insecticide may be warranted. If larvae have white eggs attached to them, they are parasitized and may not need treatment. If the larvae are almost full grown (about 4 cm or 1½ in. long), there is no benefit in applying insecticide since most of the feeding damage has already been done.	carbaryl	Sevin XLR Plus	2.5–5.25 L (1.0–2.1 L)	Alfalfa, clover and forage grasses. 2 days to harvest.

FORAGE CROP DISEASES

Table 3-2. Chemical Control Options for Diseases in Forage Crops

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEED and ROOT ROTS				
PHYTOPHTHORA ROOT ROT (<i>Phytophthora medicaginis</i>)				
Seed Treatment			per 100 kg seed	
Plant resistant varieties that are treated with metalaxyl or metalaxyl-M. Drain excess moisture and avoid compaction. Avoid stresses such as insects, weeds and untimely cuttings that may stress the plants and make them more susceptible to <i>Phytophthora</i> . Do not cut during wet conditions. Crop rotation has little affect on the disease. Promote lateral root growth with good fertility program.	metalaxyl-M	Apron XL LS	40 mL	For alfalfa, clover, and forage grasses. Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Allegiance FL	46–110 mL	
		Apron FL	46–110 mL	
PYTHIUM DAMPING-OFF (<i>Pythium</i> spp.)				
Seed Treatment			per 100 kg seed	
Drain excess moisture and avoid compaction. Plant when soil and weather conditions favour rapid emergence and early growth of seedlings. Increase plant populations to compensate for any plant losses.	metalaxyl-M	Apron XL LS	20–40 mL	Use 20–40 mL for forage grasses.
			40 mL	Use 40 mL for alfalfa, clover, trefoil and vetch.
	metalaxyl	Allegiance FL	46–110 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed-treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information on resistant strains of fungus.
			Apron FL	
FOLIAR and STEM DISEASES				
VERTICILLIUM WILT (<i>Verticillium albo-atrum</i>)				
Seed Treatment			per 100 kg seed	
Planting resistant or highly resistant varieties is the best means of control. The fungus is spread primarily on the cutting bar of forage harvesting equipment. Before harvesting, clean the cutting bar with a 1% solution of bleach followed by a clean water rinse and oil spray. Cut the youngest fields first, working towards the oldest fields. Wait 2–3 years between alfalfa crops. Maintain a good weed control program, since some weeds can be alternate hosts.	thiram	Thiram 75 WP	360 g	Alfalfa only. Do not graze treated areas or feed clippings from treated areas to livestock.

FORAGE CROP DISEASES

Table 3–2. Chemical Control Options for Diseases in Forage Crops

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
WHITE MOULD/BLOSSOM BLIGHT (<i>Sclerotinia sclerotiorum</i>/<i>Botrytis cinerea</i>)				
Foliar Treatment			per ha (per acre)	
Some differences in susceptibility between cultivars exist. Fields established under minimum tillage may have more disease. Spring planting may reduce incidence.	boscalid	Lance	420 g (170 g)	For seed production only. Ground and aerial application. Apply at 20%–50% flowering. Apply every 7–14 days if disease persists or weather conditions are favourable for disease development. Do not graze or feed treated hay to livestock. Maximum 3 applications/yr.
COMMON LEAF SPOT (<i>Pseudopeziza medicaginis</i>)				
Foliar Treatment			per ha (per acre)	
Timely harvesting of forages is important to reduce leaf loss and minimize disease in the regrowth. There are no practical control strategies available for leaf spot diseases in forages. Balance the time of harvest between the optimum stage for highest protein (bud stage in alfalfa) and the level of leaf spot disease, as leaf spot can reduce the protein level in legume leaves.	boscalid	Lance	420 g (170 g)	For seed production only. Ground and aerial application. Apply at 20%–50% flowering. Apply every 7–14 days if disease persists or weather conditions are favourable for disease development. Do not graze or feed treated hay to livestock. Maximum 3 applications/yr.
	mancozeb	Dithane DG Rainshield NT	1.46 kg (584 g)	For seed production only. Apply prior to 50% bloom. Maximum 3 applications/yr. Repeat 7–10 days after first application and 10 days after second application. Do not graze treated crop or cut for hay.
LEAF SPOT (<i>Leptosphaerulina trifolii</i>)				
Foliar Treatment			per ha (per acre)	
Timely harvesting of forages is important to reduce leaf loss and minimize disease in the regrowth. There are no practical control strategies available for leaf spot diseases in forages. Balance the time of harvest between the optimum stage for highest protein (bud stage in alfalfa) and the level of leaf spot disease, as leaf spot can reduce the protein level in legume leaves.	boscalid	Lance	420 g (170 g)	For seed production only. Ground and aerial application. Apply at 20%–50% flowering. Apply every 7–14 days if disease persists or weather conditions are favourable for disease development. Do not graze or feed treated hay to livestock. Maximum 3 applications/yr.
	mancozeb	Dithane DG Rainshield NT	1.46 kg (584 g)	For seed production only. Apply prior to 50% bloom. Maximum 3 applications/yr. Repeat 7–10 days after first application and 10 days after second application. Do not graze treated crop or cut for hay.
SPRING BLACK STEM (<i>Phoma medicaginis</i>)				
Foliar Treatment			per ha (per acre)	
Disease is favoured by cool, wet weather conditions. Cut early to reduce quality loss from premature leaf drop.	boscalid	Lance	420 g (170 g)	For seed production only. Ground and aerial application. Apply at 20%–50% flowering. Apply every 7–14 days if disease persists or weather conditions are favourable for disease development. Do not graze or feed treated hay to livestock. Maximum 3 applications/yr.

4. Cereals

WHEAT, BARLEY, OAT AND RYE INSECTS

Table 4-1. Chemical Control Options for Insects in Cereals

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
WIREWORMS (<i>Limonius</i> spp. and others)				
Seed Treatment			per 100 kg seed	
See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for sampling methods. 1 wireworm/bait trap warrants control.	thiamethoxam	Cruiser 5 FS	33–50 mL	For wheat and barley. For use in commercial seed treaters only. Use higher rate in fields with history of high infestations of larvae. See label for resistance management strategies.
EUROPEAN CHAFER (<i>Rhizotrogus majalis</i>)			per 100 kg seed	
High-risk areas are sandy knolls and areas bordering turf, pasture and tree lines. Chafer grubs can follow soybean crops on sandy soils. Avoid planting winter wheat if chafer grubs are easily found. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for more details.	thiamethoxam	Cruiser 5 FS	50 mL	For wheat and barley. For use in commercial seed treaters only. Do not graze or feed livestock on treated areas for 45 days after planting.
ARMYWORM (TRUE – <i>Pseudaletia unipuncta</i>, FALL – <i>Spodoptera frugiperda</i>)			per ha (per acre)	
5 to 6 larvae in an area 30 x 30 cm warrant chemical control. Treat if larvae <2.0 cm long and threshold has been exceeded. If larvae have white eggs attached to them, they are parasitized and may not need treatment.	trichlorfon	Dylox 420 LC	1.5 L (0.6 L)	Ground application only. Wheat, barley and oat. 21 days to harvest.
	carbaryl	Sevin XLR Plus	2.5–5.25 L (1.0–2.1 L)	14 days to harvest for wheat, rye and oat. 28 days to harvest for barley. See label precautions applying to honeybees.
	methomyl	Lannate Toss-N-Go	270–540 g (108–216 g)	Ground and aerial application. 20 days to harvest. Minimum period before re-entry is 24 hr.
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	Wheat, barley and oat. Ground and aerial application. Use 100–200 L of water/ha. 3 applications/yr. 2 may be by air. Allow a 7-day interval between treatments. Do not apply within 28 days of harvest or 14 days of livestock foraging.
	spinetoram	Delegate WG	100–200 g (40–80 g)	Ground application only. Use higher rate for heavy infestations or advanced pest stages. Minimum 5 days between treatments. Maximum 3 applications/season. Do not re-enter for 12 hr. Spray tank solution pH should be between 6 and 8 for optimal control. 21 days to harvest.
CEREAL LEAF BEETLE (<i>Oulema melanopus</i>)			per ha (per acre)	
Natural enemies are highly effective at controlling this pest. For the safety of these natural enemies, chemical control is not recommended unless pest population exceeds the action threshold of 1 larva/stem. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for more information.	malathion	Malathion 500 EC	2.2 L (880 mL)	7 days to harvest. Less effective below 20°C (68°F).

WHEAT, BARLEY, OAT AND RYE INSECTS

Table 4-1. Chemical Control Options for Insects in Cereals

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
GRASSHOPPERS (Various species)				
<p>More abundant in drier years. If populations are high enough, wheat heads may be clipped. Seedling winter wheat is also at risk. Infestations usually begin along field borders. Early-season weed control can help eliminate food source for early-season nymphs, however, late-season weed control in and around the field will actually cause this insect to migrate from the weeds onto the crop and cause damage. If populations are high, spot spray in border areas that are infested before migration into the field occurs.</p>	malathion	Malathion 500 EC	per ha (per acre) 2.25–2.75 L (900–1,100 mL)	7 days to harvest. Less effective below 20°C (68°F).
	cypermethrin	Ripcord 400 EC	50–70 mL (20–28 mL)	Ground and aerial application. Use lower rates for small grasshoppers and when soil temperatures are cool (15°C–20°C or 59°F–68°F). Avoid spraying when temperatures are above 25°C (77°F). Repeat treatment as necessary. Do not graze treated crop or cut for hay. 60 days to harvest.
	cyhalothrin-lambda	Matador 120 E Silencer 120 EC	63–83 mL (26–34 mL)	Ground and aerial application. Apply the low rate when grasshoppers are up to the 3rd nymphal stage (up to 1 cm in length) or when insect numbers are low. Apply the high rate when grasshoppers are larger, up to but not including winged adults (up to 2.5 cm in length) or when insect numbers are high. 3 applications/yr, 2 may be by air. Allow a 7-day interval between treatments. In wheat, do not apply within 28 days of harvest or 14 days of livestock foraging. In barley and oat, do not apply within 28 days of harvest or 14 days of livestock foraging.
	carbaryl	Sevin XLR Plus	1.25–2.5 L (0.5–1.0 L)	14 days to harvest for wheat, rye and oat, 28 days to harvest for barley. See label precautions applying to honeybees.
	spinetoram	Delegate WG	100–200 g (40–80 mg)	Ground only. 3 applications/yr. Re-treatment interval of 5 days. Spray tank solution pH should be between 6 and 8 for optimal control. Do not apply within 21 days of harvest.
GROWTH REGULATORS FOR LODGING REDUCTION IN CEREALS				
<p>Visit the OMAFRA website at www.ontario.ca/crops for performance trial information. High-risk factors include fields with a history of manure applications and legume hay.</p>	ethephon	Ethrel	per ha (per acre)	
			Spring Barley 1.0–1.5 L (0.4–0.6 L) 2-row cultivar	Ground and aerial application. Correct timing is critical. Use lower rate unless expecting severe lodging conditions. Apply when most of the tillers are between early flag leaf emergence to swollen boot stage (Zadok's 37–45). Do not apply after more than 10% of the awns have emerged (Zadok's 49). Use higher rates on crops that are heavily fertilized (more than 100 kg/ha of total available nitrogen) and have ample moisture (more than 25 cm of precipitation) and are prone to lodging. Do not apply within 35 days of harvest.
			1.0–2.0 L (0.4–0.8 L) 6-row cultivar	
			Spring Wheat 1.0–1.5 L (0.4–0.6 L)	
			Winter Wheat 1.25–2.5 L (0.5–1.0 L)	

WHEAT DISEASES

Table 4-2. Wheat Seed and Soil-Applied Fungicide Recommendations

Active Ingredient	Products	Formulation	Seed-Borne				Soil-Borne					Early-Season		
			Loose Smut	Seed-Borne Septoria	Seed-Borne Fusarium	Seed-Borne Dwarf Bunt	Soil-Borne Dwarf Bunt	Common Bunt	Common Root Rot	Take All	Pythium Damping-Off	Soil-Borne Fusarium	Powdery Mildew	Septoria
carbathiin + thiram	Vitaflo-280	F	+	—	+	+	—	+	+	—	—	+	—	—
difenoconazole + metalaxyl-M	Dividend XL	F	+	+	+	+	+	+	+	+	+	+	—	+
	Dividend XL RTA	F	+	+	+	+	+	+	+	+	+	+	—	+
metalaxyl-M	Apron XL	F	—	—	—	—	—	—	—	—	+	—	—	—
tebuconazole + thiram	Raxil T	F	+	+	+	—	—	+	+	—	+	+	—	—
triticonazole + thiram	Gemini	F	+	—	+	—	—	+	—	—	+	—	—	—
triadimenol	Baytan 30	F	+	—	—	—	—	+	—	+	—	—	+	—

DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable P = Powder

+ = Recommended for disease listed — = Not Recommended

¹ Suppression only.² Winter wheat only.

WHEAT DISEASES

Table 4-3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEED ROTS and SEED-BORNE DISEASES				
Use good-quality, clean seed. Apply fungicide seed treatment to all wheat seed to control soil-borne and seed-borne diseases such as seed rots and seedling blights, seed-borne septoria, seed-borne fusarium seedling blight, seed-borne dwarf bunt, common bunt and loose smut. The best protection against seedling blights, smut and the bunts can be achieved through the use of a seed treatment that contains a combination of fungicides, since no one fungicide is effective against all these diseases. Good coverage of the seed is essential, otherwise performance will be reduced.				
SEED-BORNE SEPTORIA (<i>Stagonospora nodorum</i>, formerly <i>Septoria nodorum</i>)				
Seed Treatment			per 100 kg seed	
Infected seed is lightweight and shrivelled. Fungicide seed treatment is very effective against this disease. Other options include the use of tolerant varieties and disease-free seed. Plant into a well-prepared seed bed under good growing conditions. Use wheat in at least a 3-yr rotation since the disease can survive in wheat residue.	difenoconazole + metalaxyl-M	Dividend XL RTA	650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
FUSARIUM spp. (SEED-BORNE, SEED ROT and SEEDLING BLIGHT)				
Seed Treatment			per 100 kg seed	
Infected seed is lightweight and shrivelled. Fungicide seed treatment is very effective against this disease. Other options include the use of tolerant varieties and disease-free seed. Plant into a well-prepared seedbed under good growing conditions. Use wheat in at least a 3-yr rotation since the disease can survive in wheat residue. Avoid planting wheat after corn.	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325-650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.

WHEAT DISEASES

Table 4-3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEEDLING DISEASES				
COMMON ROOT ROT (COMMON BLIGHT) (<i>Cochliobolus sativus</i>)				
Seed Treatment			per 100 kg seed	
Infected plants can be found individually or in irregular patches. These plants are often stunted and yellow (chlorotic) with a dark browning or blackening of the subcrown internodes. Drought and warm temperatures favour root rot. Maintain sound soil health practices and use good 3-yr crop rotation using non-host crops. Avoid soil compaction and deep seeding.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For suppression only. For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	carbathiin + thiram	Vitaflo 280	230–330 mL	For suppression only. Do not graze or feed livestock on treated areas for 6 weeks after planting.
FUSARIUM CROWN and FOOT ROT (<i>Fusarium graminearum</i>, <i>F. culmorum</i>, <i>F. pseudograminearum</i>)				
Seed Treatment			per 100 kg seed	
Cool, dry soils are favourable for disease development. Delay planting until conditions will result in a rapid and uniform emergence. Avoid planting after corn and maintain a balanced fertility program.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For suppression only. For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
PYTHIUM DAMPING-OFF (<i>Pythium</i> spp.)				
Seed Treatment			per 100 kg seed	
Can occur on all soil types but losses are greatest in cold, wet, clay soils. Minimize soil compaction and remove excess moisture through increased drainage. Seed treatments containing metalaxyl or metalaxyl-M can reduce infection. Delay planting until conditions will result in a rapid and uniform emergence.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	metalaxyl-M	Apron XL LS	20–40 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.

WHEAT DISEASES

Table 4-3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
PENICILLIUM and ASPERGILLUS SEED ROT (<i>Penicillium</i> spp. and <i>Aspergillus</i> spp.)				
Seed Treatment			per 100 kg seed	
Both of these diseases are considered storage moulds. Their incidence increases when wheat is stored under warm temperatures and moist conditions. Seed that is damaged is especially susceptible under these conditions. Maintain grain at less than 14% moisture and below 20°C (68°F). Avoid damaging seed during harvest or handling.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
DWARF BUNT (<i>Tilletia controversa</i>)				
Seed Treatment			per 100 kg seed	
Occurs on winter wheat, primarily in counties bordering Georgian Bay and Lake Huron where snow cover is deep and persistent in late winter and early spring. Plant seed that is free of bunt spores (black). Treat seed when bunt has been observed in the crop. Cut high with the combine. Wheat infected with dwarf bunt will be substantially shorter than healthy plants. Infected seed has a "fishy" smell. Raising the header reduces the amount of bunt balls being harvested. Coverage of the seed with fungicide seed treatments is important to their effectiveness. Avoid planting wheat in fields with soil-borne dwarf bunt for 5–7 years, since the fungus is very persistent.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	carbathiin + thiram	Vitaflo 280	230–330 mL	Seed-borne only. Do not graze or feed livestock on treated areas for 6 weeks after planting.

WHEAT DISEASES

Table 4-3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
LOOSE SMUT (<i>Ustilago tritici</i>)				
Seed Treatment			per 100 kg seed	
This fungus infects the embryo at flowering, thus is seed-borne. Light rains or heavy dew and moderate temperature, 15°C–16°C (58°F–60°F), during flowering, favour infection. Sow pedigree seed. This disease was quite important in Ontario wheat production but the incidence and hence its impact have been reduced substantially due to the effectiveness of fungicide seed treatments. Good coverage of seed with fungicide seed treatment is important.	carbathiin + thiram	Vitaflo 280	330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 55 days of planting.
	triadimenol	Baytan 30	50 mL	Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.
TAKE-ALL (<i>Gaeumannomyces graminis</i>)				
Seed Treatment			per 100 kg seed	
Carefully manage your soil fertility. Neutral to alkaline and infertile soils are most at risk. Do not apply lime before planting. Potassium and phosphorus deficiencies in the soil cause plants to be more susceptible because of poor root development. Nitrate nitrogen increases disease severity. Control grasses and avoid early planting. Use a 3-yr crop rotation and avoid planting wheat after wheat.	triadimenol	Baytan 30	100 mL	Suppression only. Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	Suppression only. For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 55 days of planting.

WHEAT DISEASES

Table 4-3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
COMMON BUNT (<i>Tilletia tritici</i> and <i>Tilletia laevis</i>)				
Seed Treatment			per 100 kg seed	
Cool soil temperatures after seeding favours this disease. This disease was quite important in Ontario wheat production, but the incidence and hence its impact has been reduced substantially due to the effectiveness of fungicide seed treatments. Use seed that is free of bunt spores (black). Infected seed produces a "fishy" smell.	carbathiin + thiram	Vitaflo 280	230–330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	Controls both seed- and soil-borne common bunt. For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 55 days of planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	triadimenol	Baytan 30	50 mL	Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated seed. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.
FOLIAR, STEM and HEAD DISEASES (See Appendix F, Cereal Growth Stages, on page 95)				
EARLY-SEASON SEPTORIA (<i>Septoria</i> spp.)				
Seed Treatment			per 100 kg seed	
Early-season septoria control may reduce the risk of later infection. However, if the flag leaf is disease-free at the time of head emergence, a fungicide will not likely be necessary.	difenoconazole + metalaxyl-M	Dividend XL RTA	650 mL	Winter wheat only. Provides control for the first 6 weeks after planting. For full-season control, apply a foliar fungicide. For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 55 days of planting.

WHEAT DISEASES

Table 4-3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEPTORIA LEAF SPOT (<i>Septoria tritici</i>)				
Foliar Treatment			per ha (per acre)	
Wet, windy weather and moderate temperatures favour disease development. Destroying volunteer wheat, reducing crop residue and crop rotation also help reduce risk. Use less susceptible varieties. See Appendix F, <i>Cereal Growth Stages</i> , on page 95.	pyraclostrobin	Headline EC	300–600 mL (120–240 mL)	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/season. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy.
	azoxystrobin + propiconazole	Quilt	750 mL (305 mL)	Ground and aerial application. Apply once between stem elongation (Zadok's 29–37) and half-head emergence (Zadok's 49–55). Maximum 1 application/season. 45 days to harvest for grain and straw. Do not harvest for forage. When disease pressure from stripe rust and wheat leaf rust is expected to be high, use the higher application rate of 1 L/ha.
	propiconazole	Tilt 250 E	250–500 mL (100–200 mL)	Ground and aerial application. Early application at GS 12–23. Use low rate for early-season disease suppression. Use higher rate for field with high disease pressure history or field conditions favourable for disease development. Later application at first sign of disease (GS 29–37) or before head is half emerged (GS 49–55). Apply only the high rate on any application from GS 29–55. Maximum 2 applications/season. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). 45 days to harvest.
	prothioconazole	Proline	315 mL (128 mL)	Ground application only. Use as a preventative when earliest disease symptoms appear on the leaves and stems. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum 2 applications/yr with a minimum 7-day interval between applications. Do not apply within 30 days of harvest.
	tebuconazole	Folicur 432 F	292 mL (118 mL)	Ground and aerial application. Only 1 application/yr. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. 36 days to harvest. Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once per year and has been traditionally used for <i>Fusarium</i> control, where applications are targeted at head emergence.
	mancozeb	Dithane DG Rainshield NT	early: 1.1 kg (440 g) late: 2.25 kg (900 g)	Use lower rate for applications at Zadok's 12–21 growth stage, when crop is in 3rd leaf to tillering. Higher rate for applications at Zadok's 59 growth stage when head is fully emerged but prior to flowering. Maximum 2 applications/yr. 40 days to harvest. Do not graze crop or cut for hay.

WHEAT DISEASES

Table 4–3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
POWDERY MILDEW (<i>Erysiphe graminis</i> f. sp. <i>tritici</i>)				
Seed Treatment			per 100 kg seed	
The fungus is very susceptible to weather conditions that promote drying of the crop environment, such as hot, dry sunny weather. Management includes the use of tolerant varieties, crop rotation, tillage and fungicides.	triadimenol	Baytan 30	50 mL	Use higher rate for winter wheat. Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated seed. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
			100 mL	
See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for thresholds and more information.				
Foliar Treatment			per ha (per acre)	
Foliar fungicide applications may be necessary when disease levels will result in yield losses and a susceptible variety is used. Thresholds for fungicide applications differ, depending on the age of the crop. Early-season powdery mildew control is warranted when 5%–10% of the lower leaves are infected, which may limit later infection. Later in the season, powdery mildew symptoms on the flag leaf (1% of leaf) and the second leaf (3%–5% of the leaf) require immediate attention, especially if prolonged wet, humid weather is forecast.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/season.
	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply a second spray before head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	tebuconazole	Folicur 432 F	292 mL (118 mL)	Ground and aerial application. Only 1 application/yr. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. 36 days to harvest.
See Appendix F, <i>Cereal Growth Stages</i> , on page 95.	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Before using Folicur for wheat leaf diseases , consider that Folicur can only be applied once/year and has been traditionally used for <i>Fusarium</i> control.
				Ground and aerial application. Maximum 2 applications/yr. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Can be tank-mixed with Buctril M in wheat. 45 days to harvest.

WHEAT DISEASES

Table 4-3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
RUST (LEAF — <i>Puccinia triticina</i> and STEM — <i>P. graminis</i> f. sp. <i>tritici</i>)				
<p>Leaf rust blows in from the southern U.S. late in the season. Minimize stem rust by removing its alternate host, common barberry. Use tolerant or resistant varieties. There are many different phenotypes (races), and wheat varieties vary in their resistance/tolerance. The development of new races could result in a once-resistant variety becoming susceptible over time. Use foliar treatments when flag leaf has 5–10 pustules (1% leaf area).</p> <p>See Appendix F, <i>Cereal Growth Stages</i>, on page 95.</p>	pyraclostrobin	Headline EC	300–600 mL (121–240 mL)	Leaf rust only. Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/season.
	azoxystrobin + propiconazole	Quilt	0.75–1.0 L (305–406 mL)	Ground and aerial application. Apply once between stem elongation (Zadok's 29–37) and half-head emergence (Zadok's 49–55). Maximum 1 application/season. 45 days to harvest for grain and straw. Do not harvest for forage. When expecting high disease pressure from stripe rust and wheat leaf rust, use the higher application rate of 1 L/ha.
	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	prothioconazole	Proline	315 mL (128 mL)	Ground application only. Use as a preventative when earliest disease symptoms appear on the leaves and stems. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum 2 applications/yr with a minimum 7-day interval between applications. Do not apply within 30 days of harvest.
	tebuconazole	Folicur 432 F	292 mL (118 mL)	Ground and aerial application. Only 1 application/yr. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. 36 days to harvest.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Before using Folicur for wheat leaf diseases, consider that Folicur can only be applied once/year and has been traditionally used for <i>Fusarium</i> control.
				Ground and aerial application. Maximum 2 applications/yr. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Can be tank-mixed with Buctril M in wheat. 45 days to harvest.
	mancozeb	Dithane DG Rainshield NT	early: 1.1 kg (440 g) late: 2.25 kg (900 g)	Leaf rust only. Use lower rate for applications at Zadok's 12–21 growth stage, when crop is in 3rd leaf to tillering. Higher rate for applications at Zadok's 59 growth stage when head is fully emerged but prior to flowering. Maximum 2 applications/yr. 40 days to harvest. Do not graze crop or cut for hay.

WHEAT DISEASES

Table 4-3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
TAN SPOT (<i>Pyrenophora tritici-repentis</i>)			per ha (per acre)	
<p>Reduced tillage and cool, cloudy, humid weather promote this disease. This disease survives in crop residues. Avoid planting wheat in conservation tillage fields in which wheat was grown during the preceding 2 years.</p> <p>See Appendix F, <i>Cereal Growth Stages</i>, on page 95.</p>	pyraclostrobin	Headline EC	300–600 mL (121–240 mL)	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/season.
	azoxystrobin + propiconazole	Quilt	750 mL (305 mL)	Ground and aerial application. Apply once between stem elongation (Zadok's 29–37) and half-head emergence (Zadok's 49–55). Maximum 1 application/season. 45 days to harvest for grain and straw. Do not harvest for forage. Use higher application rate of 1 L/ha when expecting high disease pressure from stripe rust and wheat leaf rust.
	propiconazole	Tilt 250 E	250–500 mL (100–200 mL)	Ground and aerial application. Early application at GS 12–23. Use low rate for early-season disease suppression. Use higher rate for field with high disease pressure history or field conditions favourable for disease development. Later application at first sign of disease (GS 29–37) or before head is half emerged (GS 49–55). Apply only the high rate on any application from GS 29–55. Maximum 2 applications/season. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadoks 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok 49–55). 45 days to harvest.
	prothioconazole	Proline	315 mL (128 mL)	Ground application only. Use as a preventative when earliest disease symptoms appear on the leaves and stems. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum 2 applications/yr with a minimum 7-day interval between applications. Do not apply within 30 days of harvest.
	tebuconazole	Folicur 432 F	292 mL (118 mL)	Ground and aerial application. Only 1 application/year. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. 36 days to harvest. Before using Folicur for wheat leaf diseases , consider that Folicur can only be applied once per year and has been traditionally used for <i>Fusarium</i> control, where applications are targeted at head emergence.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Ground and aerial application. Maximum 2 applications/yr. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Can be tank-mixed with Buctril M in wheat. 45 days to harvest.
	mancozeb	Dithane DG Rainshield NT	early: 1.1 kg (440 g) late: 2.25 kg (900 g)	Use lower rate for applications at Zadok's 12–21 growth stage, when crop is in 3rd leaf to tillering. Higher rate for applications at Zadok's 59 growth stage when head is fully emerged but prior to flowering. Maximum 2 applications/yr. 40 days to harvest. Do not graze crop or cut for hay.

WHEAT DISEASES

Table 4-3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
FUSARIUM HEAD BLIGHT (<i>Fusarium graminearum</i>)				
<p>Warm and prolonged wet conditions during flowering are necessary for infection to occur. Avoid planting into corn stubble, since the fungus also causes gibberella stalk rot in corn. Follow soybeans with wheat in the rotation. See the <i>Fusarium</i> forecasting web page at www.ownweb.ca to determine the fusarium head blight risk for your area and for current recommendations. Consult your local crop advisor for forecast information.</p> <p>See Appendix F, <i>Cereal Growth Stages</i>, on page 95.</p>	prothioconazole	Proline	315–420 L (128–170 mL)	Suppression only. Ground application only. Timing of application is critical. Apply from when at least 75% of the wheat heads on main stem are fully emerged (Zadok's 59) to when 50% of the heads on the main stem are in flower (Zadok's 65). Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum 2 applications/yr (735 mL/ha) with a minimum 7-day interval between applications. Do not apply within 30 days of harvest.
	tebuconazole	Folicur 432 F	292 mL (118 mL)	Suppression only. Ground and aerial application. Maximum 1 application/yr. Timing of application is critical. The optimum window for application is 1–4 days after 75% of the heads have emerged or cleared the head (Day 0). Ensure thorough coverage of all wheat heads. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum 1 application/season. Do not allow livestock to graze or feed green forage to livestock prior to 6 days after treatment. Do not enter treated fields for 12 hr after application. 36 days to harvest.
STAGONOSPORA GLUME BLOTCH (<i>Stagonospora nodorum</i>)			per ha (per acre)	
<p>Prolonged wet periods in May and early June result in increased disease incidence. Rotate with crops other than cereals, plow down cereal residues and remove volunteer wheat to reduce survivability of the fungi.</p> <p>See Appendix F, <i>Cereal Growth Stages</i>, on page 95.</p>	chlorothalonil	Bravo 500	1.5–2.5 mL (0.6–1.0 L)	Apply at Zadok's growth stage 37 (flag leaf emergence) and repeat 10–14 days later at growth stage 51–55 (visible ear). A 3rd application at growth stage 59–69 (ear fully emerged) may be necessary if conditions favour disease spread. Maximum 3 applications/yr. 30 days to harvest.
	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	prothioconazole	Proline	315–420 mL (128–170 mL)	Ground application only. Timing of application is critical. Apply from when at least 75% of the wheat heads on the main stem are fully emerged (Zadok's 59) to when 50% of the heads on the main stem are in flower (Zadok's 65). Use higher rate when expecting high disease pressure. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum 2 applications/yr (735 mL/ha) with a minimum 7-day interval between applications. Do not apply within 30 days of harvest.

WHEAT DISEASES

Table 4-3. Chemical Control Options for Diseases in Wheat

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
STRIPE RUST (<i>Puccinia striiformis</i>)			per ha (per acre)	
Can be confused with cephalosporium stripe since both will produce a yellow striping (interveinal) that can extend the entire length of the leaf. If rust is the cause, orange-yellow pustules (blisters) can be found, whereas no blistering is found in cephalosporium stripe. Most noticeable in seasons with a prolonged cool spring (3°C–15°C). Symptoms often disappear as temperatures increase.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/season.
	azoxystrobin + propiconazole	Quilt	0.75–1.0 L (305–406 mL)	Ground and aerial application. Apply once between stem elongation (Zadok's 29–37) and half-head emergence (Zadok's 49–55). Maximum 1 application/season. 45 days to harvest for grain or straw. Do not harvest for forage. When expecting high disease pressure from stripe rust and wheat leaf rust, use the higher application rate of 1 L/ha.
	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	tebuconazole	Folicur 432 F	292 mL (118 mL)	Ground and aerial application. Only 1 application/year. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Use non-ionic surfactant such as Agral 90 or Agsurf at 0.125% vol/vol. 36 days to harvest. Before using Folicur for wheat leaf diseases , consider that Folicur can only be applied once/year and has been traditionally used for <i>Fusarium</i> control.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Ground and aerial application. Maximum 2 applications/yr. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Can be tank-mixed with Buctril M in wheat. 45 days to harvest.

BARLEY, OAT AND RYE DISEASES

Table 4-4. Barley Seed and Soil-Applied Fungicide Recommendations

Active Ingredient	Products	Formulation	Seed and Seedling Blight	Barley Diseases	
				Covered Smut	True Loose Smut
carbathiin + thiram	Vitaflo 280	F	+	+	+
difenoconazole + metalaxyl-M	Dividend XL RTA	F	+	+	+
tebuconazole + thiram	Raxil T	F	+	+	+
triadimenol	Baytan 30	F	—	+	+
triticonazole + thiram	Gemini	F	+	+	+

DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable P = Powder
 + = Recommended for disease listed — = Not Recommended

Table 4-5. Oat Seed and Soil-Applied Fungicide Recommendations

Active Ingredient	Products	Formulation	Seedling Blight	Oat Diseases		
				Covered Smut	True Loose Smut	Pythium
carbathiin + thiram	Vitaflo 280	F	+	+	+	+
difenoconazole + metalaxyl-M	Dividend XL RTA	F	+	+	+	+
tebuconazole + thiram	Raxil T	F	—	+	+	—
triticonazole + thiram	Gemini	F	—	+	+	—

DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable P = Powder
 + = Recommended for disease listed — = Not Recommended

Table 4-6. Rye Seed and Soil-Applied Fungicide Recommendations

Active Ingredient	Products	Formulation	Seedling Blight	Rye Diseases			
				Seed-Borne Septoria	Common Bunt	Dwarf Bunt	Pythium Damping-Off
carbathiin + thiram	Vitaflo 280	F	+	—	—	—	+
difenoconazole + metalaxyl-M	Dividend XL RTA	F	+	+	+	+	+

DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable P = Powder
 + = Recommended for disease listed — = Not Recommended

BARLEY, OAT AND RYE DISEASES

Table 4-7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
BARLEY				
SEED and SEEDLING DISEASES				
SEED ROT and SEEDLING BLIGHT				
Seed Treatment			per 100 kg seed	
Ensure good coverage of seed treatment on seeds. Rotation with non-host crops for at least 2 yr will reduce risk. Use disease-free seed and avoid deep seeding.	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	carbathiin + thiram	Vitaflo 280	230-330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.
COCHLIOBOLUS SEEDLING BLIGHT (<i>Cochliobolus sativus</i>)				
Seed Treatment			per 100 kg seed	
Avoid continuous or overuse of barley. Avoid deep seeding. Turn under stubble to help reduce infection levels. Use resistant varieties.	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
COVERED SMUT (COMMON BUNT) (<i>Ustilago hordei</i>)				
Seed Treatment			per 100 kg seed	
Infection can occur at temperatures of 14°C-25°C (57°F-68°F), especially when the soil moisture levels are high. Seed treatment is the primary method of control.	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	triadimenol	Baytan 30	50 mL	Spring barley. Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated seed. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
	carbathiin + thiram	Vitaflo 280	230-330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.

BARLEY, OAT AND RYE DISEASES

Table 4-7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
LOOSE SMUT (<i>Ustilago nuda</i>)				
<p>Seed Treatment</p> <p>Infection occurs during flowering. Conditions that promote the disease are wet, cloudy weather and moderate temperatures 16°C–22°C (60°F–72°F). Sow pedigree seed. Moist weather at flowering promotes this disease. Use seed treatment on seed known to have high levels of infection.</p>	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	triadimenol	Baytan 30	50 mL	Must be diluted with water prior to treatment of seed to ensure uniform coverage. Treated seed will sometimes emerge more slowly than untreated seed. Avoid late seeding of winter cereals. Do not graze or feed livestock on treated areas for 40 days after planting.
	carbathiin + thiram	Vitaflo 280	230–330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
FOLIAR, STEM and HEAD DISEASES				
NET BLOTCH (<i>Pyrenophora teres</i>)			per ha (per acre)	
Avoid growing barley after barley, wheat or grasses. Plow down stubble and straw and plant early to avoid serious disease in July.	pyraclostrobin	Headline EC	300–600 mL (121–240 mL)	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/season. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy.
	azoxystrobin + propiconazole	Quilt	750 mL (305 mL)	Ground and aerial application. Apply once between stem elongation (Zadok's 29–37) and half-head emergence (Zadok's 49–55). Maximum 1 application/season. 45 days to harvest for grain or straw. Do not harvest for forage. When expecting high disease pressure from stripe rust, use the higher application rate of 1 L/ha.
	propiconazole	Tilt 250 E	250–500 mL (100–200 mL)	Ground and aerial application. Early application at GS 12–23. For early season disease suppression, use low rate. Use higher rate for field with high disease pressure history or field conditions favourable for disease development. Later application at first sign of disease (GS 29–37) or before head is half emerged (GS 49–55). Apply only the high rate on any application from GS 29–55. Maximum 2 applications/season. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	Ground and aerial application. Apply at early signs of disease from the beginning of stem elongation (Zadok's 29–37). If conditions favourable to disease continue, apply again, if necessary, before head is half emerged (Zadok's 49–55). 45 days to harvest.
	prothioconazole	Proline	210–315 mL (85–128 mL)	Ground application only. Use as a preventative when earliest disease symptoms appear on the leaves and stems. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum 2 applications/yr with a minimum 7-day interval between applications. Do not apply within 30 days of harvest.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Spring barley. Ground and aerial application. Maximum 2 applications/yr. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. 45 days to harvest.

BARLEY, OAT AND RYE DISEASES

Table 4-7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SPOT BLOTCH (<i>Cochliobolus sativus</i>)				
Avoid growing barley after barley, wheat or grasses. Plow down stubble and straw and plant early to avoid serious disease in July.	pyraclostrobin	Headline EC	per ha (per acre) 400–600 mL (160–240 mL)	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/season. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy.
	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	prothioconazole	Proline	210–315 mL (85–128 mL)	Ground application only. Use as a preventative when earliest disease symptoms appear on the leaves and stems. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum 2 applications/yr with a minimum 7-day interval between applications. Do not apply within 30 days of harvest.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Spring barley. Ground and aerial application. Maximum 2 applications/yr. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. 45 days to harvest.
SCALD (<i>Rhynchosporium secalis</i>)				
Avoid growing barley after barley, wheat or grasses. Plow down stubble and straw and plant early to avoid serious disease in July.	pyraclostrobin	Headline EC	per ha (per acre) 400–600 mL (160–240 mL)	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/season. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy.
	azoxystrobin + propiconazole	Quilt	750 mL (305 mL)	Ground and aerial application. Apply once between stem elongation (Zadok's 29–37) and half-head emergence (Zadok's 49–55). Maximum 1 application/season. 45 days to harvest for grain or straw. Do not harvest for forage. When expecting high disease pressure from stripe rust, use the higher application rate of 1 L/ha.
	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. Can be tank-mixed with several cereal herbicides. 45 days to harvest
		Bumper 418 EC	300 mL (121 mL)	
	prothioconazole	Proline	210–315 mL (85–128 mL)	Ground application only. Use as a preventative when earliest disease symptoms appear on the leaves and stems. Recommended to be used with the registered non-ionic surfactant, Agral 90 or AgSurf at 0.125% vol/vol. Maximum 2 applications/yr. Do not apply within 30 days of harvest.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Spring barley. Ground and aerial application. Maximum 2 applications/yr. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. 45 days to harvest.

BARLEY, OAT AND RYE DISEASES

Table 4–7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEPTORIA LEAF SPOT (<i>Septoria tritici</i>)			per ha (per acre)	
Avoid growing barley after barley, wheat or grasses. Plow-down stubble and straw and plant early to avoid serious disease in July.	azoxystrobin + propiconazole	Quilt	750 mL (305 mL)	Ground and aerial application. Apply once between stem elongation (Zadok's 29–37) and half head emergence (Zadok's 49–55). Maximum 1 application/season. 45 days to harvest for grain or straw. Do not harvest for forage. When expecting high disease pressure from stripe rust, use the higher application rate of 1 L/ha.
	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Spring barley. Ground and aerial application. Maximum 2 applications/yr. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. 45 days to harvest.
RUST (LEAF — <i>Puccinia hordei</i>, STEM — <i>Puccinia graminis</i> f. sp. <i>tritici</i>)			per ha (per acre)	
Leaf rust spores are blown in from the U.S. and in most years late-planted fields are most likely to show the disease. Alternate host is barberry. Remove or destroy alternate host from fence rows, etc. Plant early.	azoxystrobin + propiconazole	Quilt	1.0 L (406 mL)	Ground and aerial application. Apply once between stem elongation (Zadok's 29–37) and half-head emergence (Zadok's 49–55). Maximum 1 application/season. 45 days to harvest for grain or straw. Do not harvest for forage. When expecting high disease pressure from stripe rust, use the higher application rate of 1 L/ha.
	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. Can be tank-mixed with several cereal herbicides. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	
FUSARIUM HEAD BLIGHT (<i>Fusarium graminearum</i>)			per ha (per acre)	
Fusarium head blight infection in barley is often not as noticeable as in wheat, so examine developing heads carefully for bleached or tan spikelets. Avoid planting barley into corn residue. For more information, see FUSARIUM HEAD BLIGHT (<i>Fusarium graminearum</i>), on page 43.	prothioconazole	Proline	315–420 mL (128–170 mL)	Suppression only. Timing is critical. For optimum suppression, apply as a preventive spray from when 70%–100% of the barley main stem heads are fully emerged to 3 days after full head emergence. Maximum 2 applications/yr (735 mL/ha) with a minimum 7-day interval between applications.

BARLEY, OAT AND RYE DISEASES

Table 4-7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
OAT				
SEED and SEEDLING DISEASES				
SEED ROT and SEEDLING BLIGHT (<i>Pyrenopora avenae</i>, <i>Fusarium</i> spp. and others)				
Seed Treatment			per 100 kg seed	
Ensure good coverage of seed treatment on seeds. Rotation with non-host crops for at least 2 years will reduce risk. Use disease-free seed and avoid deep seeding.	carbathiin + thiram	Vitaflo 280	330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
COVERED SMUT (COMMON BUNT) (<i>Ustilago kollerii</i>), LOOSE SMUT (<i>Ustilago avenae</i>)				
Seed Treatment			per 100 kg seed	
Spread from year to year primarily through infected seed. Wind-blown spores will infect florets within season. Use a fungicide seed treatment on infected seed.	carbathiin + thiram	Vitaflo 280	330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	triticonazole + thiram	Gemini	360 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow or mist type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not use seed for food, feed or oil processing.
	tebuconazole + thiram	Raxil T	225 mL	For loose smut control only. Do not graze or feed livestock on treated areas for 4 weeks after planting.
PYTHIUM DAMPING-OFF (<i>Pythium</i> spp.)				
			per 100 kg seed	
Can occur on all soil types but losses are greatest in cold, wet, clay soils. Minimize soil compaction and remove excess moisture through increased drainage. Seed treatments containing metalaxyl-M can reduce infection. Delay planting until conditions will result in a rapid and uniform emergence.	carbathiin + thiram	Vitaflo 280	330 mL	Do not graze or feed livestock on treated areas for 6 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
	tebuconazole + thiram	Raxil T	225 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.

BARLEY, OAT AND RYE DISEASES

Table 4-7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
LEAF, STEM and HEAD DISEASES				
SEPTORIA LEAF SPOT (<i>Septoria tritici</i>)			per ha (per acre)	
Avoid planting oat after oat or mixed grain. Humid, wet, windy weather promotes disease.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. Can be tank-mixed with several cereal herbicides. 45 days to harvest.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Ground and aerial application. Maximum 2 applications/yr. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. 45 days to harvest.
CROWN (LEAF) RUST (<i>Puccinia coronata</i> var. <i>avenae</i>)			per ha (per acre)	
European buckthorn is the alternate host. Can be a problem in central and eastern Ontario. Use resistant varieties. Plant early to allow plants to mature before inoculum levels become heavy. Remove or destroy buckthorn.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. 45 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	Ground and aerial application. Apply at early signs of disease from tillering to head half emerged. Can be tank-mixed with several cereal herbicides. 45 days to harvest.
	trifloxystrobin + propiconazole	Stratego 250 EC	500 mL (200 mL)	Ground and aerial application. Maximum 2 applications/yr. Do not apply the second application within 14 days of the first. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. 45 days to harvest.
	pyraclostrobin	Headline EC	300-400 mL (121-160 mL)	Ground and aerial application. For optimal disease control, apply immediately after flag leaf emergence (Zadok's 37). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/yr.

BARLEY, OAT AND RYE DISEASES

Table 4-7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
RYE				
SEEDLING BLIGHT (<i>Pythium</i> spp., <i>Rhizoctonia</i> spp., <i>Fusarium</i> spp.)				
Seed Treatment			per 100 kg seed	
Sow into a well-prepared seed bed under good growing conditions. Avoid cool, wet conditions that will reduce emergence and increase seed rots and blights. Treat seed with a fungicide seed treatment.	carbathiin + thiram	Vitaflo 280	230–330 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
PYTHIUM DAMPING-OFF (<i>Pythium</i> spp.)				
Seed Treatment			per 100 kg seed	
Sow into a well-prepared seed bed under good growing conditions. Avoid cool, wet conditions that will reduce emergence and increase seed rots and blights. Treat seed with a fungicide seed treatment.	carbathiin + thiram	Vitaflo 280	230–330 mL	Do not graze or feed livestock on treated areas for 4 weeks after planting.
	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
SEED-BORNE SEPTORIA (<i>Septoria</i> spp.)				
Seed Treatment			per 100 kg seed	
Sow into a well-prepared seed bed under good growing conditions. Avoid cool, wet conditions that will reduce emergence and increase seed rots and blights. Treat seed with a fungicide seed treatment.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.
COMMON BUNT (<i>Tilletia caries</i>), DWARF BUNT (<i>Tilletia controversa</i>)				
Seed Treatment			per 100 kg seed	
Sow into a well-prepared seed bed under good growing conditions. Avoid cool, wet conditions that will reduce emergence and increase seed rots and blights. Treat seed with a fungicide seed treatment.	difenoconazole + metalaxyl-M	Dividend XL RTA	325–650 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity flow- or mist-type seed treatment equipment. May also be used in treat-on-the-go seeder. Do not graze, feed green forage or cut for hay within 35 days of planting.

BARLEY, OAT AND RYE DISEASES

Table 4-7. Chemical Control Options for Diseases in Barley, Oat and Rye

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
LEAF RUST (<i>Puccinia recondita</i> f. sp. <i>recondita</i>)				
Foliar Treatment			per ha (per acre)	
Leaf rust in rye is caused by the same fungus that infects wheat. See <i>LEAF RUST</i> , on page 39, for management options and details.	pyraclostrobin	Headline EC	300–600 mL (120–240 mL)	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/season. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy.
POWDERY MILDEW (<i>Erysiphe graminis</i> f. sp. <i>secalis</i>)				
In most cases, powdery mildew has little impact on rye since the crop is very resistant to the disease.	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground and aerial application. Apply only up to flag leaf fully emerged stage (Zadok's 39). Do not apply at boot stage (Zadok's 47) and beyond. Maximum 2 applications/season. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy.

5. Dry Edible Beans

DRY EDIBLE BEAN INSECTS

Table 5-1. Chemical Control Options for Insects in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEEDCORN MAGGOT (<i>Delia platura</i>)				
Seed Treatment			per 100 kg seed	
Seedcorn maggot problems are rare in Ontario. Risk factors include cool, wet springs when germination is delayed. In fields at high risk, including early-planted fields where large amounts of manure, green manure or residue have recently been incorporated, use Cruiser seed treatment.	thiamethoxam	Cruiser 5FS	50–83 mL	For use in commercial seed treaters only. Use higher rate when expecting high insect populations. May be mixed with Apron Maxx RTA for control of seed and soil-borne pathogens. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	For commercial application only. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. For anthracnose control, tank-mix with 10 mL of Dynasty 100FS per 100 kg seed.
	diazinon + captan + thiophanate-methyl	DCT	per 100 kg seed 1 L of slurry	Available in a 400-g container that will treat 77 kg of dry bean seed. Use full rate and ensure good coverage by applying as a slurry. To make slurry, use 520 g seed treatment/L of water.
MEXICAN BEAN BEETLE (<i>Epilachna varivestis</i>)			per ha (per acre)	
Less of a problem in very hot, dry summers. Early-maturing bean varieties and fall plantings may be grown with little or no injury. Several natural enemies help keep populations below action thresholds. Insecticides are only recommended if populations are extremely high, as they will also kill the natural enemy population.	dimethoate	Cygon 4 E	0.7–1.0 L (280–400 mL)	Do not feed treated threshings or crop refuse to livestock. 7 days to harvest.
		Lagon 480 EC	0.7–1.0 L (280–400 mL)	
	endosulfan	Thiodan 4 EC	1.5–2.5 L (0.6–1.0 L)	Do not feed treated threshings or crop refuse to livestock. 2 days to harvest.
		Thionex EC	1.5–2.5 L (0.6–1.0 L)	Do not use on lima beans.
		Thionex 50 WP	1.1–1.5 kg (400–600 g)	

DRY EDIBLE BEAN INSECTS

Table 5-1. Chemical Control Options for Insects in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
POTATO LEAFHOPPER (<i>Empoasca fabae</i>)			per ha (per acre)	
Soil Applied at Planting Only				
	phorate	Thimet 15 G	7.25–11 kg (2.9–4.4 kg)	Lock and load. Must be applied in a 10–15-cm band over the row behind the planter shoe, in front of the press wheel. Do not place in direct contact with seed. Do not feed the foliage of treated beans within 60 days.
Seed Treatments			per 100 kg seed	
Consider using insecticide seed treatment on fields with a history of leafhopper infestations, to reduce the number of foliar applications required. Research has shown insecticide seed treatment to last at least 4–6 weeks after planting, eliminating the need for at least one foliar insecticide application.	thiamethoxam	Cruiser SFS	86–143 mL	For use in commercial seed treaters only. Use higher rate when expecting high insect populations. Do not graze or feed livestock on treated areas for 45 days after planting.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	For commercial application only. Provides early-season protection (replaces one foliar insecticide spray). Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. For anthracnose control, tank-mix with 10 mL of Dynasty 100FS per 100 kg seed.
Foliar Treatment			per ha (per acre)	
Some tolerant varieties available. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for action threshold charts and sampling methods.	dimethoate	Cygon 4 E	0.7–1.0 L (280–400 mL)	Residual activity expected from this product.
		Lagon 480 EC	0.7–1.0 L (280–400 mL)	Do not feed treated threshings or crop refuse to livestock. 7 days to harvest.
	endosulfan	Thiodan 4 EC	1.5–2.5 L (0.6–1.0 L)	Do not feed treated threshings or crop refuse to livestock. 2 days to harvest.
		Thionex EC	1.5–2.5 L (0.6–1.0 L)	Do not use on lima beans.
		Thionex 50 WP	1.1–1.5 kg (400–600 g)	
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	Has no systemic activity. Ground and aerial application. For best results, apply during the early morning, before temperatures rise, and during the evening, past the heat of the day. Use 100–200 L of water/ha. Maximum 3 applications/yr. 14 days to harvest. Do not re-enter treated areas until 24 hr of treatment. Do not graze or feed on treated forage.
		Silencer 120 EC	83 mL (34 mL)	Has no systemic activity. Ground application only. For best results, apply during the early morning, before temperatures rise, and during the evening, past the heat of the day. 14 days to harvest. Maximum 3 applications/yr. Do not graze or harvest treated forage, straw or hay for livestock feed.

DRY EDIBLE BEAN INSECTS

Table 5-1. Chemical Control Options for Insects in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
TARNISHED PLANT BUG (<i>Lygus lineolaris</i>) and LYGUS spp.			per ha (per acre)	
Lygus can sting the developing pods, resulting in damaged seeds. Monitor beans during the early pod-filling stages. A treatment may be required when there are 1–2 bugs per sweep later in the season.	dimethoate	Cygon 4 E	0.7–1 L (280–400 mL)	Do not feed or allow livestock to graze treated plant material. Maximum 3 applications/season. 7 days to harvest.
		Laigon 480 E	0.7–1 L (280–400 mL)	
	cyhalothrin-lambda	Matador 120 E	83 mL (34 mL)	Has no systemic activity. Ground and aerial application. For best results, apply during the early morning, before temperatures rise, and during the evening, past the heat of the day. Use 100–200 L water/ha. Maximum 3 applications/yr. 14 days to harvest. Do not re-enter treated areas until 24 hr of treatment. Do not graze or harvest treated forage, straw or hay for livestock feed.
		Silencer 120 EC	83 mL (34 mL)	
GREEN CLOVERWORM (<i>Hypena scabra</i>)			per ha (per acre)	
Several natural enemies help keep populations below action thresholds. Insecticides are only recommended if populations are extremely high, as they will also kill the natural enemy population.	endosulfan	Thiodan 4 EC	1.5–2.5 L (0.6–1.0 L)	Do not apply on lima beans. Do not feed treated threshings or crop refuse to livestock. 2 days to harvest.

DRY EDIBLE BEAN DISEASES

Table 5–2. Dry Edible Bean Seed and Soil-Applied Fungicide Recommendations

Active Ingredients	Product	Formulation	Dry Edible Bean Diseases			
			Anthrachnose	Pythium Damping-Off	Fusarium Seedling Blight	Rhizoctonia
Insect and Disease Control						
Untreated Seed						
azoxystrobin	Dynasty 100FS ¹	F	+	—	—	+
diazinon + captan	Agrox B-2	P (DB)	—	—	+	—
diazinon + captan + thiophanate-methyl	DCT ¹	P	+	—	+	+
thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	F	—	+	+	+
Seed Pretreated With Fungicide						
diazinon + captan	Agrox CD		For insect control only. Disease control via fungicide pretreatment.			
Disease Control						
carbathiin + thiram	Vitaflo 280	LS	—	—	+	+
fludioxonil + metalaxyl-M	Apron Maxx RTA	F	—	+	+	+
	Apron Maxx RFC	F	—	+	+	+
metalaxyl	Apron FL	F	—	+	—	—
metalaxyl-M	Apron XL	LS	—	+	—	—

DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable P = Powder LS = Liquid Suspension

+ = Recommended for disease listed — = Not Recommended

¹ Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS.

DRY EDIBLE BEAN DISEASES

Table 5-3. Chemical Control Options for Diseases in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEED and SEEDLING DISEASES				
Seedling Diseases			per 100 kg seed	
Present in all fields and all soil types. Maintain or build up good soil tilth by following a good crop rotation (3 yr between bean crops of any kind), don't overwork the soil and avoiding working it when it is too wet. Apply seed treatments that will help protect the plant from root rots during germination and early growth. Use tolerant varieties.	diazinon + captan + thiophanate-methyl	DCT	1 L of slurry	Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS. Seedling blights and damping-off are also controlled. Use full rate and ensure good coverage by applying as a slurry. Available as 400-g container that will treat 77 kg of dry bean seed. To make slurry, use 520 g seed treatment/L of water. For control of pythium and phytophthora root rots, add metalaxyl.
PYTHIUM DAMPING-OFF (<i>Pythium</i> spp.)			per 100 kg seed	
Can occur on all soil types but losses are greatest on wet, clay soils. Minimize soil compaction and remove excess moisture through increased drainage. Treat seed with metalaxyl or metalaxyl-M and plant into warm soils 16°C (60°F). Rotate 3-4 yr between bean crops. Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS. See ANTHRACNOSE (<i>Colletotrichum lindemuthianum</i>), on page 61, for more details.	metalaxyl-M	Apron XL LS	20-40 mL	Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Do not graze or feed livestock on seeded area for 4 weeks after planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Allegiance FL	46-110 mL	Do not graze or feed livestock on seeded area for 4 weeks after planting.
		Apron FL	46-110 mL	
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For commercial and on-farm application. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. For anthracnose control, tank-mix with 10 mL of Dynasty 100FS per 100 kg seed.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	For commercial application only. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. For anthracnose control, tank-mix with 10 mL of Dynasty 100FS per 100 kg of seed.

DRY EDIBLE BEAN DISEASES

Table 5-3. Chemical Control Options for Diseases in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
FUSARIUM SEED and ROOT ROT (<i>Fusarium solani</i> f. sp. <i>phaseoli</i>)				
Seed Treatment Fusarium begins as small, reddish-brown lesions on the taproot that join to form larger lesions, or streaks, as the plant ages. The lesion can extend up to the soil line. Splitting of the tap root, crown and lower stem often reveals a brown-reddish internal discoloration of the water-conducting tissue. Longitudinal cracks and adventitious roots may develop on damaged plants. These adventitious roots are formed above the damaged area. Late infection seldom results in dead plants but rather in stunted, unthrifty-looking ones. Disease development is promoted by soil compaction, short crop rotations and moisture stress. Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS. See ANTHRACNOSE (<i>Colletotrichum lindemuthianum</i>), opposite page, for more details.	diazinon + captan + thiophanate-methyl	DCT	per 100 kg seed 1 L of slurry	Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS. Seedling blights and damping-off are also controlled. Use full rate and ensure good coverage by applying as a slurry. Available in a 400-g container that will treat 77 kg of dry bean seed. To make slurry, use 520 g seed treatment/L of water. For control of pythium and phytophthora root rots, add metalaxyl.
	carbathiin + thiram	Vitaflo 280	260 mL	Ensure good seed coverage.
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For commercial and on-farm application. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. For anthracnose control, tank-mix with 10 mL of Dynasty 100FS per 100 kg seed.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	For commercial application only. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. For anthracnose control, tank-mix with 10 mL of Dynasty 100FS per 100 kg of seed.
	diazinon + captan	Agrox B-2	320 mL	Available in a 2-kg container that will treat 625 kg of bean seed. Use full rate and ensure good coverage of seed. Seed within 1 month of treatment. Do not use on seed already treated with an insecticide.

DRY EDIBLE BEAN DISEASES

Table 5-3. Chemical Control Options for Diseases in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
ANTHRACNOSE (<i>Colletotrichum lindemuthianum</i>)				
Seed Treatment			per 100 kg seed	
Anthracnose is best controlled by planting disease-free seed and using a seed treatment containing DCT or Dynasty 100FS. Should disease still appear, use a foliar fungicide as a rescue treatment.	diazinon + captan + thiophanate-methyl	DCT	1 L of slurry	Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS. Available in a 400-g container that will treat 77 kg of dry bean seed. To make slurry, use 520 g seed treatment/L of water. Use full rate and ensure good coverage by applying as a slurry. For control of pythium and phytophthora root rots, add metalaxyl.
	azoxystrobin	Dynasty 100FS	10 mL	Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS. One application as a seed treatment. For additional disease control, use in combination with Apron Maxx RFC or Cruiser Maxx Beans.
Foliar Treatment			per ha (per acre)	
Rainy weather favours this disease, as spores are splashed from diseased areas and carried in wind-borne water droplets or by surface water throughout the field. Take note of weather forecasts, as wet conditions over a prolonged period of time can result in epidemics. Timing of foliar fungicides is important.	azoxystrobin	Quadris	500 mL (200 mL)	Ground and aerial application. Apply 1st application at early flower or when disease first appears. If necessary, re-apply 10–14 days later if disease persists. Maximum 2 applications/season. 15 days to harvest.
	pyraclostrobin	Headline EC	400 mL (160 mL)	Ground and aerial application. Apply when disease first appears. If necessary, re-apply 10–14 days later if disease persists. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy. Tank-mixing with Lance is not recommended, as precipitates can develop. To minimize risk of precipitates forming, use water >10 °C and spray solution promptly. Maximum 2 applications/season. 30 days to harvest.

DRY EDIBLE BEAN DISEASES

Table 5-3. Chemical Control Options for Diseases in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
RHIZOCTONIA (<i>Rhizoctonia solani</i>)			per 100 kg seed	
<p>Problem when conditions are cool and wet during planting or when these conditions result in a delay in seedling emergence or development. Mid- to-late-season moisture stress (dry conditions) can increase the disease. Management practices include: (1) Selecting varieties with good general tolerance to root rots, (2) promoting root growth through a good fertility program, (3) rotating crop (3 yr between bean crops), (4) not overworking the soil and avoiding working it when it is too wet, (5) removing excessive water through increased tile drainage and minimizing compaction and (6) applying seed treatments that protect the plant during germination and early growth.</p> <p>Due to the threat of anthracnose infection to this crop, ALL edible bean seed should be treated with DCT or Dynasty 100FS. See ANTHRACNOSE (<i>Colletotrichum lindemuthianum</i>), previous page, for more details.</p>	azoxystrobin	Dynasty 100FS	10 mL	One application as a seed treatment. For additional disease control, use in combination with Apron Maxx RFC or Cruiser Maxx Beans.
	carbathiin + thiram	VitaFlo 280	260 mL	Ensure good seed coverage.
	fludioxonil + metalaxyl-M	Apron Maxx RTA	325 mL	For both commercial seed treatment plants and on-farm treatment using standard gravity- or mist-type seed treatment equipment. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers prior to use. Ensure uniform coverage.
		Apron Maxx RFC	100 mL plus 230 mL of water	For commercial and on-farm application. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 Dynasty 100FS per 100 kg seed.
	thiamethoxam + metalaxyl-M + fludioxonil	Cruiser Maxx Beans	195 mL	For commercial application only. Compatible with <i>Rhizobium</i> -based inoculants. Check with inoculant manufacturers for details prior to use. Do not graze or feed livestock on treated areas for 45 days after planting. For anthracnose control, tank-mix with 10 mL of Dynasty 100FS per 100 kg of seed.

DRY EDIBLE BEAN DISEASES

Table 5-3. Chemical Control Options for Diseases in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
FOLIAR, STEM and POD DISEASES				
ASIAN SOYBEAN RUST (<i>Phakopsora pachyrhizi</i>)				
Edible beans are a host for Asian soybean rust. The extent to which these crops are impacted has yet to be determined. See ASIAN SOYBEAN RUST (<i>Phakopsora pachyrhizi</i>), on page 25, for more details on this disease. See the OMAFRA website at www.ontario.ca/crops for updates and further details on management options, as well as the Ontario Soybean Growers website at www.soybean.on.ca/ .	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground and aerial application. Maximum 2 applications/yr. Classified as a strobilurin fungicide; use in a preventive fungicide program (pre-infection). See label for resistance management strategy. 7 days to harvest interval.
	azoxystrobin	Quadris	500 mL (200 mL)	Ground and aerial application. Maximum 2 applications/yr. Classified as a strobilurin fungicide; use in a preventive fungicide program (pre-infection). See label for resistance management strategy. 15 days to harvest interval.
	propiconazole	Tilt 250 E	500–750 mL (200–300 mL)	Ground and aerial application. Make first application at the first sign of disease followed by a second application 14 days after the first application, if environmental conditions are favourable for disease development. Maximum 2 applications/yr. See label for resistance management strategy. 30 days to harvest interval.
	azoxystrobin + propiconazole	Quilt	1.0–1.5 L (400–600 mL)	Ground and aerial application. Make the first application at the first sign of disease. Apply the high rate only under conditions of high disease pressures. A second application at a 14-day interval may be needed if conditions persist. Good spray coverage and canopy penetration are important for best results. Apply in a minimum of 45 L of water/ha. Maximum 2 applications/yr. See label for resistance management strategy. 30 days to harvest interval.
BEAN RUST (<i>Uromyces appendiculatus</i>)				
This disease is extremely rare in Ontario, arriving late in the season. Some dry bean market classes (e.g., pinto beans) can be very susceptible to rust. If rust arrives during flowering and early pod set, a treatment may be necessary.	propiconazole	Tilt 250 E	500 mL (200 mL)	Ground and aerial application. Apply when disease is first detected. Maximum 2 applications/season. 28 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	Ground and aerial application. Apply when disease is first detected. Maximum 2 applications/season. 28 days to harvest.
	pyraclostrobin	Headline EC	400–600 mL (160–240 mL)	Ground and aerial application. Apply when disease first appears. If necessary, re-apply 10–14 days later if disease persists. Tank-mixing with insecticide is not recommended as this fungicide could affect insecticide efficacy. Tank-mixing with Lance is not recommended as precipitates can develop. Maximum 2 applications/season. 7 days to harvest.

DRY EDIBLE BEAN DISEASES

Table 5–3. Chemical Control Options for Diseases in Dry Edible Beans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
WHITE MOULD (<i>Sclerotinia sclerotiorum</i>)			per ha (per acre)	
<p>Avoid soybeans, canola and other hosts in a 3-yr rotation, since these crops are susceptible to white mould. Rotate with non-host crops such as wheat, corn and barley. In fields with a history of the disease, select varieties with an upright structure. Lower plant populations and increased row width promote rapid drying of the plants and soil surface and therefore reduce potential for infection. Avoid excess fertilization. Those fields at risk have a past history of white mould and above-average foliage growth.</p> <p>CAUTION: Before treating with Ronilan (vinclozolin), check with your dealer or buyer concerning possible foreign import restrictions on Ronilan-treated edible beans.</p>	vinclozolin	Ronilan EG	1.0 kg (400 g) 2 applications/yr 1.5 kg (600 g) 1 application/yr	<p>See Caution note under IPM Options, left. Apply at 30%–50% flowering with repeat application 7–14 days later at full bloom if disease persists. For 1 application, apply 1.5 kg at early to mid-bloom (30%–50%). Do not feed treated bean refuse to livestock. Use sufficient water to ensure thorough coverage of plant foliage. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy. Do not apply with products containing boron. 45 days to harvest for common, adzuki and mung beans.</p>
	boscalid	Lance	560–770 g (227–312 g)	<p>Best used as a preventive measure. Ground and aerial application. Apply at 20%–50% flowering. Apply a second time 7–10 days later, up to 50% flowering, if disease persists or weather conditions are favourable for disease development. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy. Tank-mixing with Headline is not recommended, as precipitates can develop. Plantback interval of 14 days for crops not on label. 21 days to harvest.</p>
	iprodione	Rovral WP	1.0–1.5 kg (0.4–0.6 kg)	<p>Apply at 25%–75% bloom. 12-hr re-entry period. Do not feed treated bean refuse to livestock.</p>
	thiophanate-methyl	Senator 70 WP	1.75–2.25 kg (700–900 g)	<p>Apply when conditions favouring development of disease exist (warm, humid weather combined with heavy, dense crop foliage). Do not feed treated bean refuse to livestock. 14 days to harvest.</p>
	dicloran	Botran 75 WP	3.25 kg (1.3 kg)	<p>Begin application when disease is anticipated, usually close to full bloom. Do not feed treated bean refuse to livestock. 2 days to harvest.</p>

6. Canola and Mustard

CANOLA AND MUSTARD INSECTS

Table 6-1. Chemical Control Options for Insects in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
FLEA BEETLES (<i>Phyllotreta cruciferae</i> and <i>Phyllotreta striolata</i>)				
Seed Treatment			per 100 kg seed	
Hot, dry weather favours this pest. Fortunately, once the crop reaches the 3-4-leaf stage, the plants are generally established and can compensate for the feeding damage.	imidacloprid	Gaucho 480 FL	820-1,640 mL	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Do not graze livestock on treated areas for 4 weeks after planting. Do not use mustard greens that have had Gaucho 480 FL seed treatment for human consumption. Use higher rate if flea beetle populations are high.
If beetle damage exceeds 50% of the cotyledon or leaf area, and if the weather is warm and dry, a foliar insecticide may be needed.	thiamethoxam + difenoconazole + metalaxyl M + fludioxonil	Helix Xtra	1.5 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Follow resistance management recommendations as stated on label.
Canola and mustard are a valuable honey source and are well used by honeybees. Keep insecticide application to a minimum while the crop is in bloom.	imidacloprid + carbathiin + thiram	Gaucho CS FL	1.4 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Do not graze livestock on treated areas for 4 weeks after planting. Do not use mustard greens that have had Gaucho CS FL seed treatment for human consumption. Follow resistance management recommendations as stated on label.
	clothianidin + carbathiin + thiram + metalaxyl	Prosper FL	1.25 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. 30-day plant-back on cereal grains, grasses, non-grass animal feeds, and soybean and dried beans is required. 1-year plant-back interval is required for leafy, root and tuber vegetables. Can be tank-mixed with Poncho 600 FS for longer season control of flea beetles. Follow resistance management recommendations as stated on label.

CANOLA AND MUSTARD INSECTS

Table 6-1. Chemical Control Options for Insects in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
Postemergence				
Canola is a valuable honey source and is utilized by honeybees. Bees also pollinate the crop. If spraying an insecticide, ensure there are no honey-producing hives in your area.			per ha (per acre)	
	cypermethrin	Ripcord 400 EC	50 mL (20 mL)	Canola only. Ground application only. Apply when signs of insect damage appear. Repeat treatment if necessary. Use minimum 110 L of water/ha. 30 days to harvest.
	deltamethrin	Decis 5 EC	100-150 mL (40-60 mL)	Ground and aerial application. 14 days to harvest.
	cyhalothrin-lambda	Matador 120 EC Silencer 120 EC	83 mL (33 mL)	Ground and aerial application. Maximum 3 applications/yr. I may be by air. Tank-mixing with clay-based fungicides (e.g., Lance or Ronalin) is not recommended as these fungicides may affect insecticide efficacy. Do not apply within 7 days of harvest.
	carbaryl	Sevin XLR Plus	500 mL (200 mL)	Seedling stage only (up to 4 weeks after plant emergence). Ground and aerial application. 60 days to harvest.
	carbofuran	Furadan 480 F	150 mL (60 mL)	Ground and aerial application. Apply 2 weeks after seeding or when insects are first noticed. Do not use less than 100 L of water. 60 days to harvest for canola and 21 days to harvest or grazing on mustard. Minimum period for re-entry is 48 hr.
DIAMONDBACK MOTH (<i>Plutella xylostella</i>)				
Damage is most noticeable during dry years. Risk factors include weedy fields and no-till. Cool, cloudy weather reduces moth activity and if this persists, females will die before eggs are laid.	cyhalothrin-lambda	Matador 120 EC	83 mL (33 mL)	Ground and aerial application. Maximum 3 applications/yr. I may be by air. Tank-mixing with clay-based fungicides (e.g., Lance or Ronalin) is not recommended as these fungicides may affect insecticide efficacy. Do not apply within 7 days of harvest.
		Silencer 120 EC		
Canola is a valuable honey source and is utilized by honeybees. Bees also pollinate the crop. If spraying an insecticide, ensure there are no honey-producing hives in your area.				

CANOLA AND MUSTARD INSECTS

Table 6-1. Chemical Control Options for Insects in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
CABBAGE SEEDPOD WEEVIL (<i>Ceutorhynchus obstrictus</i>)				
Serious pest in winter canola, though can also impact early-planted spring canola. Adult weevils lay eggs directly into the seedpod. Pod feeding by the larvae can cause up to 35% yield loss. Apply insecticide to adults prior to egg-laying, as foliar insecticide will not control larvae within the canola pod. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for further information on pest biology and management options. Canola is a valuable honey source and is utilized by honeybees. Bees also pollinate the crop. If spraying an insecticide, ensure there are no honey-producing hives in your area.	cyhalothrin-lambda	Matador 120 EC	83 mL	For adult control only. Ground and aerial application. Apply at bud-to-early-flowering stage. Maximum 1 application/yr. Tank-mixing with clay-based fungicides (e.g., Lance or Ronalin) is not recommended, as these fungicides may affect insecticide efficacy. Do not apply within 7 days of harvest.
		Silencer 120 EC	(33 mL)	
SWEDE MIDGE (<i>Contarinia nasturtii</i>)				
New pest of canola in Ontario. Under heavy midge infestations, later-planted spring canola plants may experience stunting and malformed growth, with extremely reduced flower and pod formation. Thresholds and spray timing are not available at this time. For more information on this pest, see OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for further information on pest biology and management options.				No registered products at this time.
TARNISHED PLANT BUG (<i>Lygus lineolaris</i>)				
Tarnished plant bug sting plant tissue, including pods and flowers. This causes scarring, malformation and dimpling or pitting on pods. They can also drill into the seed. If flowers are still present, they can prick the flower and cause it to abort. Though no thresholds have been validated for Ontario, spraying is recommended when 2 bugs per sweep are found after petal fall.	cyhalothrin-lambda	Matador 120 EC Silencer 120 EC	83 mL (33 mL)	Ground and aerial application. Apply at bud-to-early-flowering stage. Maximum 1 application/yr. Tank-mixing with clay-based fungicides (e.g., Lance or Ronalin) is not recommended, as these fungicides may affect insecticide efficacy. Do not apply within 7 days of harvest.

CANOLA AND MUSTARD DISEASES

Table 6-2. Chemical Control Options for Diseases in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SEEDLING DISEASES				
SEED ROT and SEEDLING BLIGHT (<i>Alternaria</i> and <i>Rhizoctonia</i>)			per 100 kg seed	
Plant good quality seed under conditions that promote rapid germination (warm temperatures). Using a fungicide seed treatment will increase stand establishment. Maintain a good fertility balance and avoid excess fertilizer, which promotes disease and phytotoxicity. Avoid deep planting of seed.	thiamethoxam + difenoconazole + metalaxyl-M + fludioxonil	Helix Xtra	1.5 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Follow resistance management recommendations as stated on label.
	carbathiin + thiram	Vitavax RS Fungicide	833 mL	Do not graze or feed livestock on seed area for 4 weeks after planting.
	imidacloprid + carbathiin + thiram	Gaucho CS FL	1.4 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Do not graze livestock on treated areas for 4 weeks after planting. Do not use mustard greens that have had Gaucho CS FL seed treatment for human consumption. Follow resistance management recommendations as stated on label.
PYTHIUM DAMPING-OFF (<i>Pythium</i> spp.)			per 100 kg seed	
Plant good quality seed under conditions that promote rapid germination (warm temperatures). Using metalaxyl or metalaxyl-M seed treatment will increase stand establishment. Maintain a good fertility balance and avoid excess fertilizer, which promotes disease and phytotoxicity. Avoid deep planting of seed.	metalaxyl-M	Apron XL LS	20-40 mL	Canola only. Do not use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment applications at or immediately before planting. Read label for information regarding resistant strains of fungus.
	metalaxyl	Apron FL	32-110 mL	Canola only. Do not graze or feed livestock on seeded area for 4 weeks after planting.
	thiamethoxam + difenoconazole + metalaxyl M + fludioxonil	Helix Xtra	1.5 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Follow resistance management recommendations as stated on label.

CANOLA AND MUSTARD DISEASES

Table 6-2. Chemical Control Options for Diseases in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
BLACKLEG (<i>Leptosphaeria maculans</i>)				
Seed Treatment			per 100 kg seed	
There are differences in susceptibility between cultivars. Maintain at least 3 y between canola crops. Fungicide seed treatments will reduce seed-borne infection.	thiamethoxam + difenoconazole + metalaxyl M + fludioxonil	Helix Xtra	1.5 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Follow resistance management recommendations as stated on label.
	carbathiin + thiram	Vitavax RS Fungicide	833 mL	Do not graze or feed livestock on seed area for 4 weeks after planting.
	imidacloprid + carbathiin + thiram	Gaucho CS FL	1.4 L	Not for use in hopper-box, planter-box, slurry-box or other non-commercial seed treatment application. Do not graze livestock on treated areas for 4 weeks after planting. Do not use mustard greens that have had Gaucho CS FL seed treatment for human consumption. Follow resistance management recommendations as stated on label.
Foliar Treatment			per ha (per acre)	
A foliar fungicide may be warranted if blackleg symptoms occur at the seedling and rosette stages or if a susceptible variety is being grown.	propiconazole	Tilt 250 E	500 mL (200 mL)	Canola only. Ground and aerial application. Apply at rosette stage. Do not feed treated canola refuse to livestock. 60 days to harvest.
		Bumper 418 EC	300 mL (121 mL)	Canola only. Apply during the rosette stage, between 2nd true leaf and bolting. 60 days to harvest.
	azoxystrobin	Quadris	500 mL (200 mL)	Canola only. Apply at 2-6-leaf stage. See label for information regarding resistant strains of fungus. Plant-back interval of 30 days for broadleaf and root crops and 45 days for cereals required. 30 days to harvest.

CANOLA AND MUSTARD DISEASES

Table 6–2. Chemical Control Options for Diseases in Canola and Mustard

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
SCLEROTINIA STEM ROT (WHITE MOULD) (<i>Sclerotinia sclerotiorum</i>)				
This disease is often a problem when canola follows canola, white beans, soybeans or sunflowers. Use clean seed and a 4–5-year rotation with non-host crops such as corn, wheat, barley or oats. At present, no resistant varieties exist. Keep fields clean of broad-leaved weeds, since many are alternate hosts.	vinclozolin	Ronilan EG	0.5 kg (0.2 kg) 2 applications 0.75–1.0 kg (300–400 g) 1 application	Canola only. For 2 applications, apply first at 20%–30% flowering and second 7 days later at late bloom (50%), if disease persists. For single application at higher rates, apply at 20%–50% flower. Use the high rate where conditions are extremely favourable for disease development (heavy crop canopy, high humidity and/or excessive rainfall). Do not feed treated canola refuse to livestock. Use sufficient water to ensure thorough coverage of plant foliage. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy. Do not apply with products containing boron. 40 days to harvest.
	iprodione	Rovral WP	1.0–1.5 kg (0.4–0.6 kg)	Canola only. Ground and aerial application. Apply at 20%–30% bloom. 12-hr re-entry period.
	azoxystrobin	Quadris	700–1,000 mL (283–405 mL)	Canola only. Apply at early bloom (prior to 30% bloom). See label for information regarding resistant strains of fungus. Plant-back interval of 30 days for broadleaf and root crops and 45 days for cereals required. 30 days to harvest.
	boscalid	Lance	350 g (142 g)	Canola only. Ground and aerial application. Apply at 20%–50% flowering. Apply a second time 7–10 days later up to 50% flowering if disease persists or weather conditions are favourable for disease development. Tank-mixing with insecticide is not recommended, as this fungicide could affect insecticide efficacy. 21 days to harvest.
	prothioconazole	Proline	315–368 mL (128–149 mL)	Ground and aerial application. Apply when the crop is in the 20%–50% bloom stage. Best protection will be achieved when applied prior to petals beginning to fall. Higher rate is recommended for fields with a history of heavy disease pressure or for dense plant stands. Good spray coverage is essential. The lowest label rate of a non-ionic surfactant, AgSurf or Agral 90 may be tank-mixed. Maximum 1 application/yr. Do not apply within 36 days of harvest.

7. Stored Grain

STORED-GRAIN INSECTS

Table 7-1. Chemical Control Options for Insects in Corn, Wheat and Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
RUSTY GRAIN BEETLE (<i>Cryptolestes ferrugineus</i>)				
Protectant The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for more information on stored-grain insect management.	diatomaceous earth	Protect-It	Empty bin: 500 g per 100 m ² Stored grain: 500–1,000 g/ metric tonne of grain	Can be applied to dry containers where grain is transported or stored. The structure must remain empty for 1–2 weeks. For maximum effectiveness, the relative humidity must remain below 55% and the temperature above 15°C (59°F). See label for spot and crack treatment rates. For wheat grain treatment, 100 g/tonne of wheat can be used to control rusty grain beetle. Dust may be applied to grain as it enters the auger or conveyor feeder system during grain transfer into the storage facility.
Fumigant			Grain bin, per 100 m³	
	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	Must be applied by a professional licensed applicator. Do not fumigate below 5°C (40°F). Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is tightly sealed. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	
INDIAN MEAL MOTH (<i>Plodia interpunctella</i>)				
Protectant The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for more information on stored-grain insect management.	diatomaceous earth	Protect-It	Empty bin: 500 g per 100 m ² Stored grain: 500–1,000 g/ metric tonne of grain	Apply at monthly intervals with the first appearance of moths and continue until early fall. In severe infestations, break up webbing with a rake before dusting and make second application 2 weeks later. Can be applied to dry containers where grain is transported or stored. The structure must remain empty for 1–2 weeks. For maximum effectiveness, the relative humidity must remain below 55% and the temperature above 15°C (59°F). See label for spot and crack treatment rates. Dust may be applied to grain as it enters the auger or conveyor feeder system during grain transfer into storage facility.
Fumigant			Grain bin, per 100 m³	
	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	Must be applied by a professional licensed applicator. Do not fumigate below 5°C (40°F). Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is as tightly sealed as possible. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	

STORED-GRAIN INSECTS

Table 7-1. Chemical Control Options for Insects in Corn, Wheat and Soybeans

Integrated Pest Management Options	Active Ingredient	Trade Name	Rate	Comments (Days to harvest, label precautions, etc.)
GRANARY WEEVIL (<i>Sitophilus granarius</i>)				
Protectant				
The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for more information on stored-grain insect management.	diatomaceous earth	Protect-It	Empty bin: 500 g per 100 m ²	Can be applied to dry containers where grain is transported or stored. The structure must remain empty for 1–2 weeks. For maximum effectiveness, the relative humidity must remain below 55% and the temperature above 15°C (59°F). See label for spot and crack treatment rates. Dust may be applied to grain as it enters the auger or conveyor feeder system during grain transfer into the storage facility.
			Stored grain: 500–1,000 g/ metric tonne of grain	
Fumigant				
	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	Must be applied by a professional licensed applicator. Do not fumigate below 5°C (40°F). Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is as tightly sealed as possible. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	
LESSER GRAIN BORER (<i>Rhyzopertha dominica</i>)				
Fumigant				
The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for more information on stored-grain insect management.	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	Must be applied by a professional licensed applicator. Do not fumigate below 5°C (40°F). Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is as tightly sealed as possible. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	
PEA WEEVILS/BEAN WEEVILS (<i>Bruchus pisorum</i>/ <i>Acanthoscelides obtectus</i>)				
Fumigant				
The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for more information on stored-grain insect management.	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	Must be applied by a professional licensed applicator. Do not fumigate below 5°C (40°F). Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is as tightly sealed as possible. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	
EUROPEAN GRAIN MOTH (<i>Nemapogon granella</i>)				
Fumigant				
The key to controlling stored-grain insects is prevention through good sanitation and storage practices. See OMAFRA Publication 811, <i>Agronomy Guide for Field Crops</i> , for more information on stored-grain insect management.	aluminum phosphide	Fumitoxin	880–2,560 pellets 250–500 tablets	Must be applied by a professional licensed applicator. Do not fumigate below 5°C (40°F). Exposure to moist air or liquids releases flammable and toxic phosphine gas. Ensure bin is as tightly sealed as possible. Not to be used for vacuum fumigations. See label for minimum length of pest exposure periods at various temperatures.
		Phostoxin	880–2,560 pellets 250–500 tablets	
		Gastoxin	880–2,500 pellets 180–500 tablets	

8. Using Pesticides in Ontario

Read the latest product label before using a pesticide!

Review the *Grower Pesticide Safety Course Manual*.

Keep detailed spray records.

Federal Registration of Pesticides

Before a pesticide can be sold or used in Ontario, it must be registered under the federal *Pest Control Products Act* and be classified under the provincial *Pesticides Act*. The Pest Management Regulatory Agency (PMRA) of Health Canada registers pesticides for use in Canada following an evaluation of scientific data to ensure that the product has merit and value. It also ensures that the human health and environmental risks associated with its proposed use are acceptable.

The PMRA re-evaluates registered pesticides to determine whether today's health and environmental protection standards are still met when following the label directions. Outcomes of a re-evaluation can be:

- no change in the registration
- label amendments (i.e., changes to personal protective equipment requirements, re-entry intervals and buffer zones)
- modifications to existing maximum residue limits (MRLs)
- elimination or phasing-out of certain uses or formulations
- no further acceptance of the registration

The pesticide label is a legal document. It prescribes how the pesticide can be legally used. Off-label use is prohibited. It is against the law to use the pesticide in any other way or on any other crop or pest than as specified on the label. Labels for all registered pesticides are under Label Search, on the PMRA website at www.pmr-arla.gc.ca. Ensure you have the most current label and are aware of any re-evaluation decisions.

Regulation of Pesticides in Ontario

The Ministry of the Environment (MOE) is responsible for regulating the sale, use, transportation, storage and disposal of pesticides in Ontario. Ontario regulates pesticides by placing appropriate education, licensing and/or permit requirements on their use, under the *Pesticides Act* and Regulation 63/09. All pesticides must be used in accordance with requirements under the *Pesticides Act* and Regulation 63/09, which are available on the e-laws website at www.e-laws.gov.on.ca or by calling ServiceOntario at 1-800-668-9938 or 416-326-5300.

Classification of Pesticides

The Ontario Pesticides Advisory Committee (OPAC) is responsible for reviewing and recommending to the MOE the classification of pesticide products before they can be sold or used in Ontario. Pesticide products are classified on the basis of their toxicity, environmental or health hazard, persistence of the active ingredient or its metabolites, concentration, usage, federal class and registration status. This classification system provides the basis for regulating the distribution, availability and use of pesticide products in Ontario. Once approved by the MOE, classified products are posted on the MOE website at www.ene.gov.on.ca.

The Ontario pesticide classification system changed from 6 Schedules to 11 Classes (Regulation 63/09).

Certification and Licensing Growers and their Assistants

For information about certification for growers and training for assistants to growers, visit the Ontario Pesticide Education Program website at www.opec.ca or call 1-800-652-8573.

Commercial Applicators (Exterminators) and Their Assisting Technicians

For more information about exterminator licensing and technician training, visit the Ontario Pesticide Training & Certification website at www.ontariopesticide.com/OPTC/default.htm or call 1-888-620-9999 or 519-674-1575.

For more information about pesticide regulations, certification and licensing, see:

- Inside front cover of this publication
- Pest Management Regulatory Agency (PMRA) website: www.pmr-arla.gc.ca
- PMRA Pest Management Information Service: 1-800-267-6315 (from within Canada) or 1-613-736-3799 (from outside Canada)
- Ontario Ministry of the Environment (MOE) website: www.ene.gov.on.ca
- Regional MOE Pesticides Specialist (See Appendix C. *Ontario Ministry of the Environment Regional Contact Information*, on page 91.)
- Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) website: www.ontario.ca/omafra
- Ontario Pesticide Education Program (Ridgetown College) website: www.oep.ca
- Ontario Pesticide Training & Certification website: www.ontariopesticide.com/OPTC/default.htm

Pesticide Application Information

When you decide to use a pesticide, choose the most appropriate formulation and application method for your situation. Use only a properly calibrated sprayer. Choose less toxic alternatives when possible. Take all possible precautions to prevent the exposure of people and non-target organisms to the pesticide. Read the most current pesticide label thoroughly before application. The label provides important information, such as:

- directions for use (rates of application, crops it can be used on, target pests, crop rotation restrictions, total number of applications, droplet size/nozzle type, application equipment, timing and ideal weather conditions)

- required personal protective equipment
- health hazards and toxicity
- re-entry intervals
- buffer zones
- special warnings
- steps to be taken in case of an accident
- disposal

For more information on hazards, consult the Material Safety Data Sheet (MSDS) or contact the manufacturer.

Re-Entry Intervals

The re-entry interval, also referred to as restricted entry interval (REI), is the period of time following a pesticide application during which workers must not enter the treatment area without wearing protective clothing and personal protective equipment. This allows any pesticide residue and vapours to dissipate from the treatment location (e.g., field), preventing the possibility of inadvertent pesticide exposure.

The PMRA reviews each pesticide to determine whether the label should include a specific re-entry interval. If the re-entry interval is not stated on the label, assume that the spray solution must be dry before re-entry can occur. Some pesticides have labels that carry a warning about working in treated crops. Follow the label recommendations. See Table 9-5, *Re-Entry Intervals for Pesticides Used on Field Crops*, on page 85.

Days to Harvest for Food Crops: Preharvest Intervals, Pregrazing and Feeding Intervals

These intervals state the minimum time that must pass between the last pesticide application and the harvesting of the crop, or the grazing or cutting of the crop for livestock feed. If you harvest a crop before the preharvest interval (PHI) has passed, there may be pesticide residues in excess of the maximum residue limits (MRLs) set by PMRA.

**To avoid exceeding the maximum residue limits,
always follow the directions on the label.**

Buffer Zones

Buffer zones are areas left untreated to protect an adjacent sensitive area, such as sensitive terrestrial and aquatic habitats, well heads, non-target crops and areas where children play.

Leave a suitable buffer zone between the treatment area and adjacent sensitive areas. Buffer zones may vary depending on the method of application (i.e., aerial, field boom, hand-held sprayer). Some pesticide labels specify buffer zone requirements. Check the pesticide label for the type of buffer zone required.

Sensitive terrestrial habitats include hedgerows, grasslands, shelterbelts, windbreaks, forested areas, woodlots, vegetative strips, etc.

Sensitive aquatic habitats include lakes, reservoirs, streams, creeks, ditches, marshes, wetlands, ponds, commercial fish ponds, etc.

Setback Distances for Water Bodies

It is an offence under the federal *Fisheries Act* to introduce into water any material that may be harmful to fish or fish habitat. To protect these waters, applicators must determine a suitable setback distance between the area to be protected and the area where pesticide treatments are planned (if one is not specified on the pesticide label). The protected area includes the water body as well as adjacent riparian (riverbank) areas that contribute to fish food and habitat.

Protect the Environment

Protect Water Sources

According to the British Crop Protection Council, between 40% and 70% of surface water pesticide contamination comes from mixing and filling areas.

Only load or mix pesticides on impermeable surfaces that are safely away from watercourses or environmentally sensitive areas. Drainage and run-off should be collected and disposed of safely.

Clean your spray equipment away from wells, ponds, streams and ditches. Apply the diluted rinse water (usually at a ratio of 10 to 1) to the treatment area (crop) but do not exceed the pesticide rate recommended on the label.

Do not make a direct connection between any water supply (e.g., public supply, wells, watercourse or pond) and a spray tank. Use an anti-backflow

device or intermediate system to prevent back-siphoning that could contaminate the water supply.

Immediately contain and clean up any spills to prevent contamination to water sources.

Check the pesticide label for specific instructions on water source protection.

For more information on protecting water sources, see:

- OMAFRA Factsheet, *Pesticide Contamination of Farm Water Supplies: Recommendations on Avoidance, Cleanup and Responsibilities*, Order No. 00-099
- OMAFRA Factsheet, *Groundwater – An Important Rural Resource: Protecting the Quality of Groundwater Supplies*, Order No. 06-115
- OMAFRA/Agriculture and Agri-Food Canada booklet, *Best Management Practices – Pesticide Storage, Handling and Application*, Order No. BMP13

Prevent Bee Poisoning

It is important to protect bees when spraying insecticides. Honeybees, as well as other bees and insects, are important pollinators of crops. Many crops also offer bees sources of nectar for honey production.

Read each pesticide label for specific precautions regarding bees. Choose less toxic alternatives when possible. Most organophosphate and carbamate insecticides are highly toxic to bees.

Advise local beekeepers before you apply a pesticide, so that they may take additional precautions to protect their bees. Contact the Provincial Apiarist at 1-888-466-2372, ext. 63595, for a list of the beekeepers in your area. Follow guidelines regarding spray timing to prevent unnecessary poisonings. For more information on preventing bee poisoning, see the OMAFRA Factsheet, *Code of Practice to Prevent Bee Poisoning in Fresh Market Sweet Corn*, Order No. 08-031.

Manage Drift

- Do not spray when wind speeds are high or gusty. These conditions will favour spray drift. Check pesticide labels for allowable wind speeds for spraying applications. Some labels may not provide this specific information. Constantly monitor wind conditions during spraying, using a good quality

wind meter. Record the wind speed and direction. As wind conditions change, you may need to make adjustments to further reduce the drift potential, such as adjusting water volume upwards, minimizing nozzle-to-target distance, changing nozzle technology, changing fields because of surrounding influences or stop spraying until conditions improve.

- Do not spray during periods of dead calm. Periods of dead calm usually occur in early morning or late evening, at which time the temperature is usually cooler and the relative humidity is typically higher. The combination of these factors can result in drift-sized droplets staying in the field. When the wind picks up, these spray droplets can move away from the target area, possibly causing injury to adjacent non-target areas.
- Use the recommended sprayer output (water volume).
- Use a nozzle that will produce the appropriate droplet size if specified on the pesticide label.
- Use the most appropriate nozzle for the type of application. Where practical, use air induction/venturi nozzles, which significantly reduce drift when compared to conventional nozzles.
- Check the height of the boom to the target and minimize the distance as much as possible while still maintaining spray uniformity.
- Follow buffer zone requirements for the protection of adjacent sensitive areas as outlined on the pesticide label.
- Use spray plume protection where practical or available (hoods, shrouds, screens and air curtains).
- Use drift-reducing adjuvants in the spray tank as directed on the label.
- Use wick weeders instead of spraying when possible.
- Use non-volatile pesticide formulations or products.

For more information about spray drift, see:

- OMAFRA/Agriculture and Agri-Food Canada booklet, *Best Management Practices – Pesticide Storage, Handling and Application*, Order No. BMP13
- Ontario Pesticide Education Program (Ridgetown College) videos *How to Manage Spray Drift* and *Spray Drift Reduction Through Air Induction*, available at www.opep.ca/Educational/EducationalMaterials.htm

Pesticide Disposal

Empty Pesticide Containers

Never reuse empty containers. Puncture the cleaned empty containers to make them unusable.

The Ontario Empty Pesticide Container Recycling Program is available to growers and commercial applicators. Through this program, you can return cleaned and triple rinsed plastic/metal pesticide containers (up to 23 L for plastic and 20 L for metal) to pesticide container depots located throughout the province. Remove the paper booklet from the pesticide container before recycling. To locate the closest pesticide container recycling depot, call the Ontario Pesticide Education Program at 1-800-652-8573, your local dealer or municipality, or visit the CropLife Canada website at www.croplife.ca.

Surplus Spray Mix

The best way to dispose of any excess spray mix is to find other fields that require an application of this pesticide. Before spraying, check the label to make sure the pesticide is registered for use on that crop.

If you cannot find another field to spray, dilute the remaining spray mix by adding 10 parts of water for each 1 part of spray mix. The diluted solution can be safely applied to the original treated area as long as you do not exceed the pesticide rate recommended on the label. Be sure to check the label for any restrictions about crop rotation, days to harvest or surplus spray mix disposal.

Never re-spray the treated field with undiluted spray mix. Spraying an area twice will double the recommended pesticide rate. This may cause illegal pesticide residues in the harvested crop or harmful residues in the soil that can cause crop damage.

Surplus Pesticides in Storage

Be sure to safely dispose of pesticides that you do not need or cannot use. Options for proper disposal include:

- Contact the supplier. It is sometimes possible to return unused pesticide if it is still in its original, unopened container.
- Hire a waste hauler who is licensed under Part V of the *Environmental Protection Act* to carry hazardous wastes. Look in the yellow pages of your telephone directory under Liquid Waste Removal.
- Check your local paper or visit the CropLife Canada website (www.croplife.ca) for upcoming Obsolete Pesticide Collection Days.
- Contact your municipality to see if any waste collection days are scheduled and verify whether quantities of agricultural pesticides will be accepted.

Storing Pesticides

Ontario's *Pesticides Act* and Regulation 63/09 provide details on storage requirements for storage facilities. The storage requirements that must be followed are dependent on which classes of pesticides you store.

For more information about storing pesticides, see:

- OMAFRA Factsheet, *Farm Pesticide Storage Facility*, Order No. 07-059
- OMAFRA/Agriculture and Agri-Food Canada booklet, *Best Management Practices – Pesticide Storage, Handling and Application*, Order No. BMP13
- Ontario Pesticide Education Program (Ridgetown College) Grower Pesticide Safety Course Manual, available at www.opep.ca/Educational/EducationalMaterials.htm

Pesticide Spills

If a pesticide spill causes, or is likely to cause, an adverse effect that is greater than that which would result from the proper use of the pesticide, you must notify the Ministry of the Environment Spills Action Centre at 1-800-268-6060 (24 hours a day, 7 days a week) and your municipality.

A spill is defined as a discharge of pollutant, which is abnormal in quality or quantity, from or out of a structure, vehicle or other container into the environment. An incident such as an overturned pesticide sprayer, which results in the loss of the spray solution to the environment, is an example of a spill. A pesticide container that ruptures and leaks its contents is another example of a spill. The discharge or spraying of a pesticide in an unapproved area, commonly referred to as an overspray, is also considered a spill.

Before you begin to clean up a spill of any nature, remember to protect yourself against pesticide exposure. Wear the proper protective clothing and personal protective equipment. If the spill occurs inside an enclosed area (e.g., a pesticide storage area or a vehicle during transport), ventilate the area first. Once you have protected and/or removed yourself and other persons or animals from the spill site, take additional measures to stop the spill at the source and prevent it from spreading and/or contaminating watercourses. Specific precautions, emergency contact information and first aid procedures may be found on the label.

For minor spills, it may be possible to remediate the problem:

- **For a liquid spill** – Cover the spill with a thick layer of absorbent material such as kitty litter, vermiculite or dry soil. Sweep or shovel the material into a waste drum and dispose of the contents as you would a hazardous waste.
- **For a dust, granular or powder spill** – Sweep or shovel the material into a waste drum and dispose of the contents as you would a hazardous waste.

For major spills, it is essential to stop the spill from spreading. The clean-up guidelines above may not be appropriate for all spill situations. Once you have contained the spill, follow directions from the manufacturer and regulatory authorities on cleaning the contaminated area.

For information on preventing spills, see:

- OMAFRA Factsheet, *Ways to Avoid Pesticide Spills*, Order No. 96-025
- OMAFRA/Agriculture and Agri-Food Canada booklet, *Best Management Practices – Pesticide Storage, Handling and Application*, Order No. BMP13
- Ontario Pesticide Education Program (Ridgetown College) Grower Pesticide Safety Course Manual, available at www.opep.ca/Educational/EducationalMaterials.htm

For pesticide poisonings and pesticide injuries call:

Poison Information Centre:

1-800-268-9017

(TTY) 1-877-750-2233

For more information, see inside back cover on Emergency and First Aid Procedures for Pesticide Poisoning.

9. Pesticides Used on Field Crops in Ontario

Table 9-1. Seed Treatments Used on Field Crops

TRADE NAME	Active Ingredient	Chemical Family	Risk of Resistance Developing ¹	Formulation	Crops	Manufacturer
Fungicides						
Anchor	carbathiin + thiram	anilide + dithiocarbamates	low	F (DB)	soybeans	Bayer CropScience
Allegiance FL	metalaxyl	acylamine	medium	F	soybeans, forages, corn, cereals, canola	Bayer CropScience
Apron FL	metalaxyl	acylamine	medium	F	soybeans, forages, corn, cereals, canola	Bayer CropScience
Apron XL LS	metalaxyl-M	acylamine	medium	LS	soybeans, corn, canola, wheat, forages, beans	Syngenta Crop Protection
Apron Maxx RTA	fludioxonil + metalaxyl-M	phenylpyrrole + acylamine	low to medium	F	soybeans, dry edible beans	Syngenta Crop Protection
Apron Maxx RFC	fludioxonil + metalaxyl-M	phenylpyrrole + acylamine	low to medium	F	soybeans, dry edible beans	Syngenta Crop Protection
Baytan 30	triadimenol	triazole	low to medium	F	wheat, barley	Bayer CropScience
Captan FL	captan	phthalimide	low	F	beans, corn, soybeans	Norac Concepts Inc.
Dividend XL RTA	difenoconazole + metalaxyl-M	triazole + acylamine	low to medium	F	wheat	Syngenta Crop Protection
Dynasty 100FS	azoxystrobin	strobilurin	low	F	corn, dry edible beans	Syngenta Crop Protection
Gemini	triticonazole + thiram	triazole + dithiocarbamate	low to medium	F	wheat, barley, oat	BASF Canada
Maxim 480 FS	fludioxonil	phenylpyrrole	low	F	corn, soybeans	Syngenta Crop Protection
Raxil T	tebuconazole	triazole	low to medium	F	wheat, barley, oat	Bayer CropScience
Thiram 75 WP	thiram	dithiocarbamates and relatives	low	P	alfalfa	Bayer CropScience
VitaFlo 280	carbathiin + thiram	anilide + dithiocarbamates	low	F	barley, wheat, oat, flax, dry edible beans, soybeans, rye, corn	Bayer CropScience
Vitavax RS Fungicide	carbathiin + thiram	anilide + dithiocarbamates	low	F	canola, mustard, rapeseed	Bayer CropScience

DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable LS = Liquid Suspension P = Powder

¹ Risk of resistance based on continuous use of product.

Table 9-1. Seed Treatments Used on Field Crops

TRADE NAME	Active Ingredient	Chemical Family	Risk of Resistance Developing ¹	Formulation	Crops	Manufacturer
Insecticides						
Cruiser 5FS	thiamethoxam	chloronicotine	medium to high	F	corn, soybeans, edible beans, wheat, barley	Syngenta Crop Protection
Cruiser 350FS	thiamethoxam	chloronicotine	medium to high	F	wheat, barley, beans	Syngenta Crop Protection
Gaucho 480FL	imidacloprid	chloronicotine	medium to high	F	canola, mustard, seed corn only	Bayer CropScience
Poncho 600FS	clothianidin	chloronicotine	medium to high	F	canola, corn	Bayer CropScience
Fungicides With Insecticides						
Agrox B-2	diazinon + captan	organophosphate + phthalimide	low	P (DB)	corn, beans, soybeans	Norac Concepts Inc.
Agrox CD	diazinon + captan	organophosphate + phthalimide	low	P (DB)	corn, beans, soybeans	Norac Concepts Inc.
Cruiser Maxx Beans	thiamethoxam + metalaxyl-M + fludioxonil	chloronicotine + acylamine + phenylpyrrole	low to medium	F	soybeans, dry edible beans	Syngenta Crop Protection
DCT	diazinon + captan + thiophanate-methyl	organophosphate + phthalimide + benzimidazole	low	P (DB)	dry edible beans	Norac Concepts Inc.
Gaucho CS	imidacloprid + carbathiin + thiram	chloronicotine + anilide + dithiocarbamates	low to medium	F	canola, mustard, rapeseed	Bayer CropScience
Helix Xtra	thiamethoxam + difenoconazole + metalaxyl-M + fludioxonil	chloronicotine + triazole + acylamine + phenylpyrrole	low to medium	F	canola, mustard	Syngenta Crop Protection
Prosper	clothianidin + carbathiin + thiram + metalaxyl	chloronicotine + anilide + dithiocarbamates + acylamine	low to medium	F	canola, rapeseed	Bayer CropScience
DB = Drill Box Application EC = Emulsifiable Concentrate F = Flowable LS = Liquid Suspension P = Powder						

¹ Risk of resistance based on continuous use of product.

Table 9-2. Foliar Fungicides Used on Field Crops

TRADE NAME	Active Ingredient	Fungicide Classification	Days to Harvest	Relative Toxicities	Aerial Application	Manufacturer	Use and Notes
Botran 75 W	dichloran	nitroaniline	2	low	yes	Gowan Company	field beans
Bumper 418 EC	propiconazole	triazole	corn: 14 cereals: 45 canola: 60 beans: 28	low	yes for all crops listed	UAP Canada Inc.	wheat, oat, barley, corn, canola, dry edible beans, soybeans (for seed only)
Dithane DG Rainshield	mancozeb	dithiocarbamate	wheat: 40	low	yes for all crops listed	Dow AgroSciences	spring and winter wheat, alfalfa (for seed only)
Folicur 432 F	tebuconazole	triazole	wheat: 36	low	yes for all crops listed	Bayer CropScience	wheat, soybeans
Headline EC	pyraclostrobin	strobilurin	corn: 7 soybeans: 21 beans: 7 oat: See notes.	low	yes for all crops listed except corn	BASF Canada	corn, soybeans, wheat, barley, rye, oat, dry edible beans Note: Do not apply to oat after the boot stage (Zadok's 47 and beyond.)
Lance WDG	boscalid	carboxamide	21	low	yes for all crops listed	BASF Canada	canola, dry edible beans
Proline	prothioconazole	triazole	barley: 30 wheat: 30 canola: 36	low	yes for all crops listed except for all cereals	Bayer Crop Sciences	barley, wheat, canola
Quadris	azoxystrobin	strobilurin	canola: 30 soybeans: 15 seed corn: 7 beans: 15	low	yes for all crops listed except seed corn	Syngenta Crop Protection	canola, seed corn, dry edible beans, soybeans
Quilt	azoxystrobin + propiconazole	strobilurin + triazole	soybeans: 30 beans: 30 corn: 14 corn for silage: 30 wheat: 45 barley: 45	low	yes for all crops listed	Syngenta Crop Protection	beans, soybeans, corn, wheat, barley
Ronilan EG	vinclozolin	dicarboximide	beans: 45 canola: 40	low	yes for all crops listed except beans	BASF Canada	dry edible beans, canola
Rovral WP	iprodione	dicarboximide	14	low	yes for all crops listed	Bayer CropScience	dry edible beans, canola
Senator 70 WP	thiophanate-methyl	benzimidazole	14	low	yes for all crops listed	Engage Agro	white beans
Stratego 250 EC	trifloxystrobin + propiconazole	strobilurin + triazole	45	low	yes for all crops listed	Bayer CropScience	wheat, barley, oat
Tilt 250 E	propiconazole	triazole	corn: 14 soybeans: 30 cereals: 45 canola: 60 beans: 28	low	yes for all crops listed	Syngenta Crop Protection	wheat, oat, barley, corn, canola, dry edible beans, soybeans

Table 9-3. Foliar Insecticides Used on Field Crops

TRADE NAME	Active ingredient	Insecticide Classification	Days to Harvest	Relative Toxicities	Aerial Application	Manufacturer	Use and Notes
Cygon 480 EC	dimethoate	organophosphorus	alfalfa: 2 beans: 7 soybeans: 30 canola: 21 forages: 2	moderate	yes for all crops listed	Cheminova Canada	alfalfa, field beans, soybeans, canola, forages Toxic to bees
Decis 5.0 EC	deltamethrin	pyrethroid	canola: 14 corn: 5	moderate	yes for all crops listed except corn	Bayer CropScience	canola, corn, mustard, wheat, barley, oat Toxic to bees
Delegate WG	spinetoram	spinosyn	cereals: 21 soybeans: 28	low	no	Dow AgroSciences Canada	wheat, barley, oat, rye, soybeans
Dipel 2X DF	<i>Bacillus thuringiensis</i>	bacterial toxin	0	low	yes	Valent BioSciences	timothy, corn
Force 3 G	tefluthrin	pyrethroid	Planting time only	moderate	no	Syngenta Crop Protection	corn
Furadan 480 F	carbofuran	carbamate	canola: 60	high	yes for all crops listed	Bayer CropScience	canola, mustard Toxic to bees
Imidan 50 WP	phosmet	organophosphorus	7	moderate	no	Gowan Company	alfalfa Toxic to bees
Lagon 480 EC	dimethoate	organophosphorus	alfalfa: 2 beans: 7 soybeans: 30 canola: 21 cereal: 2	moderate	yes for all crops listed	United Agri Products	soybeans, beans, canola, alfalfa, cereals Toxic to bees
Lannate Toss-N-Go 90 SP	methomyl	carbamate	cereals: 20 canola: 8	high	yes for all crops listed	Dupont Canada	cereals, canola Toxic to bees
Lorsban 4 E 15 G	chlorpyrifos	organophosphorus	corn: 70 canola: 21 wheat: 60	moderate	yes for all crops listed except corn	Dow AgroSciences	corn, cereals, canola Toxic to bees
Malathion 500 EC	malathion	organophosphorus	alfalfa: 7 cereals: 7 corn: 7 beans: 3	low	no	United Agri Products	alfalfa, cereals, field beans, soybeans, corn Toxic to bees Less effective below 20 C
Matador 120 EC	cyhalothrin-lambda	pyrethroid	corn: 14 canola: 7 wheat: 28 beans: 14 soybeans: 21	moderate	yes for all crops listed	Syngenta Crop Protection	corn, canola, alfalfa, wheat, barley, oat, soybeans, beans
Pounce EC	permethrin	pyrethroid	canola: 1	moderate	no	FMC Corp.	canola, cereals, corn, flax, sunflowers

Table 9-3. Foliar Insecticides Used on Field Crops

TRADE NAME	Active ingredient	Insecticide Classification	Days to Harvest	Relative Toxicities	Aerial Application	Manufacturer	Use and Notes
Pyrifos 15G	chlorpyrifos	organophosphorus	Planting time only	moderate	no	United Agri Products	corn
Pyrinex 480 EC	chlorpyrifos	organophosphorus	corn: 70 cereals: 60 canola: 21	moderate	yes for all crops listed except corn	United Agri Products	corn, canola, cereals Toxic to bees
Ripcord 400 EC	cypermethrin	pyrethroid	canola: 30 wheat: 30 barley: 45 corn: 5	moderate	yes for all crops listed except wheat, barley and canola	BASF Canada	canola, corn, wheat Toxic to bees
Sevin XLR Plus	carbaryl	carbamate	beans: 5 alfalfa: 2 oat: 14 wheat: 14 barley: 28 corn: 1	moderate	yes for all crops listed except beans and canola	Bayer CropScience	alfalfa, cereals, beans, corn, canola Toxic to bees
Silencer 120 EC	cyhalothrin-lambda	pyrethroid	corn: 14 canola: 7 wheat: 28 barley: 28 oat: 28 beans: 14 soybeans: 21	moderate	yes for all crops listed except soybeans and beans	Makhteshim Agan of North America Inc.	corn, canola, alfalfa, wheat, barley, oat, soybeans, beans
Thimet 15 G	phorate	organophosphorus	Planting time only	high	no	BASF Canada	corn
Thiodan 4 EC	endosulfan	organo-chlorine	beans: 2 corn: 50 alfalfa, rye: 30	moderate	no	Bayer CropScience	field beans, corn, alfalfa, rye Toxic to bees
Thionex EC	endosulfan	organo-chlorine	beans: 2 corn: 50 alfalfa: 30 rye: 30	moderate	no	United Agri Products	field beans, corn, alfalfa, rye Toxic to bees
Thuricide HPC	<i>Bacillus thuringiensis</i>	bacterial toxin	0	low	yes	Thermo Trilogy	timothy

Table 9-4. Transgenic Crops Expressing Insecticidal or Fungicidal Traits

TRADE NAME	Event	Cry Protein (delta endotoxin)	Bt Strain	Manufacturer	Pests Controlled	Remarks ¹
Agrisure CB	BtII	Cry IAb	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i>	Syngenta Seeds Canada	European corn borer	
Agrisure RW	MIR604	mCry 3A	<i>Bacillus thuringiensis</i> var. <i>SanDiego</i> (tenebrionis)	Syngenta Seeds Canada	corn rootworm larvae	
Agrisure CB/RW	BtII and MIR604	Cry IAb and mCry 3A	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i> and <i>Bacillus thuringiensis</i> var. <i>SanDiego</i> (tenebrionis)	Syngenta Seeds Canada	European corn borer corn rootworm	
Herculex I	TC1507	Cry IF	<i>Bacillus thuringiensis</i> var. <i>aizawai</i>	Dow AgroSciences/ Pioneer Hi-Bred International	European corn borer black cutworm* fall armyworm	* May only provide control of young larvae
Herculex RW	DAS-59122-7	Cry 34AbI and Cry 35AbI	<i>Bacillus thuringiensis</i> strain PSI49BI	Dow AgroSciences/ Pioneer Hi-Bred International	corn rootworm larvae	
Herculex Xtra	TC1507 and DAS-59122-7	Cry IF and Cry 34AbI/ Cry 35AbI	<i>Bacillus thuringiensis</i> var. <i>aizawai</i> and <i>Bacillus thuringiensis</i> strain PSI49BI	Dow AgroSciences/ Pioneer Hi-Bred International	European corn borer black cutworm* fall armyworm corn rootworm larvae	* May only provide control of young larvae
KnockOut	Event 176	Cry IAb	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i>	Syngenta Seeds Canada	European corn borer (ECB)	May not provide complete protection against 2nd generation ECB. Does not protect against ECB damage to the ear
NatureGard	Event 176	Cry IAb	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i>	Dow AgroSciences/ Mycogen Seeds	European corn borer (ECB)	May not provide complete protection against 2nd generation ECB. Does not protect against ECB damage to the ear
YieldGard	MON810	Cry IAb	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i>	Monsanto Canada Inc.	European corn borer	
YieldGard	BtII	Cry IAb	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i>	Syngenta Seeds Canada	European corn borer	
YieldGard Rootworm	MON863	Cry 3BbI	<i>Bacillus thuringiensis</i> var. <i>SanDiego</i> (tenebrionis)	Monsanto Canada Inc.	corn rootworm larvae	
YieldGard Plus	MON810 and MON863	Cry IAb and Cry 3BbI	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i> and <i>Bacillus thuringiensis</i> var. <i>SanDiego</i> (tenebrionis)	Monsanto Canada Inc.	European corn borer corn rootworm larvae	
YieldGard VT Triple	MON810 and MON88017	Cry IAb and Cry 3BbI	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i>	Monsanto Canada Inc.	European corn borer corn rootworm larvae	

¹ Insect resistance management strategies must be followed when planting Bt corn. See *A Grower's Handbook: Controlling Corn Insect Pests With Bt Corn Technology*, found at www.cornpest.ca for more information.

Table 9-5. Re-Entry Intervals for Pesticides Used on Field Crops

Trade Name	Active Ingredient	Re-Entry Interval
Decis 5.0 EC	deltamethrin	12 hr
Delegate WG	spinetoram	12 hr
Folicur 432 F	tebuconazole	12 hr
Furadan 480 F	carbofuran	48 hr ¹
Headline EC	pyraclostrobin	12 hr (7 days for corn hand harvesting/detasseling)
Imidan 50 WP	phosmet	5 days for alfalfa
Lance WDG	boscalid	4 hr
Lannate Toss-N-Go 90 SP	methomyl	24 hr
Lorsban 4 E 15 G	chlorpyrifos	24 hr
Matador 120 EC	cyhalothrin-lambda	24 hr
Silencer 120 EC		
Pounce EC	permethrin	when dry
Proline	prothioconazole	24 hr
Pyrifos 15G	chlorpyrifos	24 hr
Pyrinex 480 EC		
Quadris	azoxystrobin	when dry
Quilt	azoxystrobin + propiconazole	12 hr
Rovral WP	iprodione	12 hr
Stratego 250 EC	trifloxystrobin + propiconazole	12 hr
Thimet 15 G	phorate	48 hr
Thionex EC	endosulfan	48 hr

¹ If prolonged direct contact with corn foliage will occur, do not enter treated fields within 14 days of application without wearing protective equipment.

Table 9-6. Pesticides Used in Field Crops that Affect Cholinesterase Levels in Blood

Active Ingredient	Trade Name
carbaryl	Sevin XLR
carbofuran	Furadan 480 F
chlorpyrifos	Lorsban 4E Pyrinex 480 EC Pyrifos 15G
diazinon	Agrox B-2 Agrox CD
dimethoate	Cygon 480 Lagon 480
malathion	Malathion 500 EC
methomyl	Lannate Toss-N-Go
phosmet	Imidan 50 WP
phorate	Thimet 15G
terbufos	Counter

Table 9-7. Relative Toxicity of Insecticides to Honeybees

Trade Name	Active Ingredient
Group 1 – Very toxic. Do not apply to flowering crops or weeds	
Cygon 480	dimethoate
Lagon 480	
Furadan 480 F	carbofuran
Imidan 50 WP	phosmet
Lannate Toss-N-Go	methomyl
Lorsban 4E	chlorpyrifos
Pyrifos 15G	
Pyrinex 480 EC	
Malathion 500 EC	malathion
Ripcord 400EC	cypermethrin
Sevin XLR	carbaryl
Group 2 – Apply only during late evenings or early morning¹	
Decis 5.0 EC	deltamethrin
Thiodan 4 EC	endosulfan
Thionex EC	

¹ Unusually low temperatures at time of application may cause insecticides to remain toxic up to 20 times longer than during warm weather. High temperatures in the early morning or late evening may extend active foraging by bees.

10. Appendices

Appendix A.

Manufacturers of Pesticides Recommended in Publication 812

BASF Canada Inc.

110 Milverton Dr., 5th floor
Mississauga, Ontario L5R 4H1
Tel 1-877-371-2273
Fax 1-289-360-6001
www.agsolutions.ca

Bayer CropScience

100-3131 114th Ave. SE
Calgary, Alberta T2Z 3X2
Tel 1-888-283-6847
Fax 403-723-7488
www.bayercropscience.ca

Bio-Lab Canada – A Chemtura Company

1005 Copperstone Dr.
Pickering, Ontario L1W 4A5
Tel 905-686-8836
Fax 905-619-8696
www.chemtura.com

Dow AgroSciences Solutions Centre

#201-1144 29th Ave. NE
Calgary, Alberta T2E 7P1
Tel 1-800-667-3852
Fax 1-888-296-6188
www.dowagro.ca

DuPont Canada Inc.

7070 Mississauga Rd., Box 2300
Streetsville, Ontario L5M 2H3
Tel 1-800-387-2122
Fax 905-821-5653
<http://ca.dupont.com>

Engage Agro Corp.

848 Gordon St.
Guelph, Ontario N1G 1Y7
Tel 519-826-7878
Fax 519-826-7675
www.engageagro.com

Gowan Company

370 South Main St.
Yuma, Arizona US 85364
Tel 1-800-883-1844, ext. 2
www.gowanco.com

Growmark Inc.

2000 Argentia Rd., P.O. Box 634
Mississauga, Ontario L5M 2C1
Tel 905-814-4266
Fax 905-814-4341
www.growmark.com

Interprovincial Cooperative Ltd.

945 Marion St.
Winnipeg, Manitoba R2J 0K7
Tel 204-233-3461
www.ipco.ca

Makhteshim Agan of North America Inc.

4515 Falls of Neuse Rd., Ste. 300
Raleigh, North Carolina US 27609
Tel 919-256-9300

Monsanto Canada

67 Scurfield Blvd.
Winnipeg, Manitoba R3T 1G4
Tel 1-800-667-4944
Fax 204-488-9599
www.monsanto.ca

Norac Concepts Inc.

P.O. Box 31097
Guelph, Ontario N1H 8K1
Tel 519-821-3633
Fax 519-821-2083
www.noracconcepts.com

Syngenta Crop Protection Canada Inc.

140 Research Lane
Guelph, Ontario N1G 4Z3
Tel 1-800-459-2422
Fax 519-823-8439
www.syngenta.ca

Syngenta Seeds Canada Inc.

15910 Medway Rd.
Arva, Ontario N0M 1C0
Tel 1-800-756-7333
Fax 1-888-717-7122
www.nkcanada.com

Thermo Trilogy Corporation

9145 Guilford Rd., Ste. 175
Columbia, Maryland US 21046

United Agri Products Canada Inc.

789 Donnybrook Dr.
Dorchester, Ontario N0L 1G5
Tel 1-800-265-4624
Fax 519-268-8013
www.uap.ca

Valent BioSciences Canada Ltd.

19 Wildan Dr. Box 19
Freelton, Ontario L0R 1K0
Tel 905-659-0886
Fax 905-659-0885
www.valentbiosciences.com

Appendix B.

Ontario Ministry of Agriculture, Food and Rural Affairs Crop Advisory Staff List by Location

Brighton Resource Centre		Tel: 613-475-1630	
95 Dundas St. E, RR#3, Brighton, ON K0K 1H0		Fax: 613-475-3835	
IPM Systems Specialist	Margaret Appleby	Tel: 613-475-5850	margaret.appleby@ontario.ca
Guelph OMAFRA			
1 Stone Rd. W., Guelph, ON N1G 4Y2			
Agroforestry Specialist	Todd Leuty	Tel: 519-826-3215 Fax: 519-826-4964	todd.leuty@ontario.ca
Crop Bioproducts Specialist	Mahendra Thimmanagari	Tel: 519-826-4593 Fax: 519-826-4964	mahendra.thimmanagari@ontario.ca
Crop Protection Program Lead	Denise Beaton	Tel: 519-826-6594 Fax: 519-826-4964	denise.beaton@ontario.ca
Director, Agriculture Development Branch	Aileen MacNeil	Tel: 519-826-6588 Fax: 519-826-3567	aileen.macneil@ontario.ca
Manager, Field Crops	Dawn Pate	Tel: 519-826-3257 Fax: 519-826-3567	dawn.pate@ontario.ca
Manager, Greenhouse, Agroforestry and Specialty Crops	Annette Anderson	Tel: 519-826-3286 Fax: 519-826-3567	annette.anderson@ontario.ca
Manager, Horticulture Technology	Hugh Berges	Tel: 519-826-3288 Fax: 519-826-3567	hugh.berges@ontario.ca
Manager, Horticulture Crops	Bob Forrest	Tel: 519-826-6941 Fax: 519-826-3567	bob.forrest@ontario.ca
Minor Use Coordinator	Jim Chaput	Tel: 519-826-3539 Fax: 519-826-4964	jim.chaput@ontario.ca
Organic Crop Production Program Lead	Hugh Martin	Tel: 519-826-4587 Fax: 519-826-4964	hugh.martin@ontario.ca
Potato Specialist	Eugenia Banks	Tel: 519-826-3678 Fax: 519-826-4964	eugenia.banks@ontario.ca
Product Development Specialist	Laurie Butter	Tel: 519-826-4094 Fax: 519-826-3567	laurie.butter@ontario.ca
Vegetable Crops Specialist	Jennifer Allen	Tel: 519-826-4963 Fax: 519-826-4964	jennifer.allen@ontario.ca
Harrow			
Greenhouse and Processing Crops Research Centre, 2585 County Road 20, Harrow, ON N0R 1G0		Tel: 519-738-2251 Fax: 519-738-4564	
Apple Specialist	Leslie Huffman	Tel: 519-738-1256	leslie.huffman@ontario.ca
Greenhouse Vegetable IPM Specialist	Gillian Ferguson	Tel: 519-738-1258	gillian.ferguson@ontario.ca
Greenhouse Vegetable Specialist	Shalin Khosla	Tel: 519-738-1257	shalin.khosla@ontario.ca

Appendix B.

Ontario Ministry of Agriculture, Food and Rural Affairs Crop Advisory Staff List by Location

Kemptville Resource Centre		Tel: 613-258-8295	
P.O. Box 2004, Concession Rd, Kemptville, ON K0G 1J0		Fax: 613-258-8392	
Agroforestry Specialist	Vacant	Tel: 613-258-8302	
Emerging Crops Specialist	Scott Banks	Tel: 613-258-8359	scott.banks@ontario.ca
Field Crops, IPM Program Lead – Bilingual	Gilles Quesnel	Tel: 613-258-8250	gilles.quesnel@ontario.ca
Lindsay Resource Centre		Tel: 705-324-6125	
322 Kent St. W, Lindsay, ON K9V 2Z9		Fax: 705-324-1638	
Forage Specialist	Joel Bagg	Tel: 705-324-5856	joel.bagg@ontario.ca
New Liskeard		Tel: 1-800-461-6132	
280 Armstrong St., P.O. Box 4070, New Liskeard, ON P0J 1P0		Fax: 705-647-7993	
Agriculture and Rural Representative	Daniel Tassé	Tel: 705-647-2085	daniel.tasse@ontario.ca
Ridgetown Resource Centre		Tel: 519-674-1690	
Agronomy Building, Ridgetown College, P.O. Box 400, Main St. E, Ridgetown, ON N0P 2C0		Fax: 519-674-1564	
Entomology, Field Crops Program Lead	Tracey Baute	Tel: 519-674-1696	tracey.baute@ontario.ca
Pathologist – Field Crops Program Lead	Albert Tenuta	Tel: 519-674-1617	albert.tenuta@ontario.ca
Soil Management Specialist – Field Crops	Adam Hayes	Tel: 519-674-1621	adam.hayes@ontario.ca
Soil Management Specialist	Anne Verhallen	Tel: 519-674-1614	anne.verhallen@ontario.ca
Vegetable Crops Specialist	Janice LeBoeuf	Tel: 519-674-1699	janice.leboeuf@ontario.ca
Vegetable Crops Specialist	Elaine Roddy	Tel: 519-674-1616	elaine.rodry@ontario.ca
Weed Management Program Lead – Horticulture	Kristen Callow	Tel: 519-674-1335	kristen.callow@ontario.ca
Simcoe Resource Centre		Tel: 519-426-7120	
P.O. Box 587, Blueline Rd. & Hwy #3, Simcoe, ON N3Y 4N5		Fax: 519-428-1142	
Application Technology Specialist	Jason Deveau	Tel: 519-426-8934	jason.deveau@ontario.ca
Berry Crop Specialist	Pam Fisher	Tel: 519-426-2238	pam.fisher@ontario.ca
Fresh Market Quality Program Lead	Jennifer R. DeEll	Tel: 519-426-1408	jennifer.deell@ontario.ca
Ginseng and Medicinal Herbs Specialist	Sean Westerveld	Tel: 519-426-4323	sean.westerveld@ontario.ca
IPM Specialist – Specialty Crops	Melanie Filotas	Tel: 519-426-4434	melanie.filotas@ontario.ca
New Crop Development Specialist	vacant	Tel: 519-426-4509	
Pome Fruit IPM Specialist	Kathryn Carter	Tel: 519-426-4322	kathryn.carter@ontario.ca
Transition Crop Specialist	Jim Todd	Tel: 519-426-3823	jim.todd@ontario.ca
Stratford Resource Centre		Tel: 519-271-0280	
581 Huron St., Stratford, ON N5A 5T8		Fax: 519-273-5278	
Canola & Edible Beans Specialist	Brian Hall	Tel: 519-271-0083	brian.hall@ontario.ca
Cereals Specialist	Peter Johnson	Tel: 519-271-8180	peter.johnson@ontario.ca
Soil Fertility Specialist	Keith Reid	Tel: 519-271-9269	keith.reid@ontario.ca
Soybean Specialist	Horst Bohner	Tel: 519-271-5858	horst.bohner@ontario.ca

Appendix B.**Ontario Ministry of Agriculture, Food and Rural Affairs Crop Advisory Staff List by Location**

University of Guelph		Tel: 519-824-4120	
50 Stone Rd. E., Guelph, ON N1G 2W1			
Applied Research Coordinator – Field Crops Crop Science Building	Ian McDonald	Tel: 519-824-4120, ext. 56707 Fax: 519-763-8933	ian.mcdonald@ontario.ca
Corn Industry Program Lead Crop Science Building	Greg Stewart	Tel: 519-824-4120, ext. 54865 Fax: 519-763-8933	greg.stewart1@ontario.ca
Nursery Crops Specialist Edmund Bovey Building	Jennifer Llewellyn	Tel: 519-824-4120, ext. 52671 Fax: 519-767-0755	jennifer.llewellyn@ontario.ca
Nutrition – Horticulture Program Lead Land Resource Science, Richards Building	Christoph Kessel	Tel: 519-824-4120, ext. 52480 Fax: 519-824-5730	christoph.kessel@ontario.ca
Pathologist – Horticulture Crops Program Lead Edmund Bovey Building	Michael Celetti	Tel: 519-824-4120, ext. 58910 Fax: 519-767-0755	michael.celetti@ontario.ca
Turfgrass Specialist, Guelph Turfgrass Institute 328 Victoria Rd. S., R.R. # 2 Guelph, ON N1H 6H8	Pam Charbonneau	Tel: 519-824-4120, ext. 52597 Fax: 519-766-1704	pamela.charbonneau@ontario.ca
Weed Management Field Crops Program Lead, Crop Science Building, Room 303	Mike Cowbrough	Tel: 519-824-4120, ext. 52580 Fax: 519-763-8933	mike.cowbrough@ontario.ca
Vineland – University of Guelph		Tel: 905-562-4141	
4890 Victoria Ave. N., P.O. Box 7000, Vineland Station, ON L0R 2E0		Fax: 905-562-3413	
Greenhouse Floriculture Specialist	Wayne Brown	Tel: 905-562-4141, ext. 179	wayne.brown@ontario.ca
Greenhouse Floriculture IPM Specialist	Graeme Murphy	Tel: 905-562-4141, ext. 106	graeme.murphy@ontario.ca
Vineland Resource Centre		Tel: 905-562-4147	
Adv. Serv. Building, P.O. Box 8000, 4890 Victoria Ave. N., Vineland Station, ON L0R 2E0		Fax: 905-562-5933	
Entomology, Horticulture Program Lead	Hannah Fraser	Tel: 905-562-1674	hannah.fraser@ontario.ca
Nutrient Management Horticulture Crops Program Lead	Donna Speranzini	Tel: 905-562-1170	donna.speranzini@ontario.ca
Tender Fruit and Grape IPM Specialist	Wendy McFadden-Smith	Tel: 905-562-3833	wendy.mcfadden-smith@ontario.ca
Tender Fruit and Grape Specialist	Ken Slingerland	Tel: 905-562-1639	ken.slingerland@ontario.ca
Woodstock Resource Centre		Tel: 519-537-6621	
P.O. Box 666, Hwy. #59 N, Woodstock, ON N4S 7Z5		Fax: 519-539-5351	
Nutrient Management Field Crops Program Lead	Christine Brown	Tel: 519-537-8305	christine.brown1@ontario.ca

Agricultural Information Contact Centre

Provides province-wide, toll-free technical and business information to commercial farms, agri-businesses and rural businesses.

1 Stone Rd. W.

Guelph, ON N1G 4Y2

Tel: 519-826-4047

Toll-free: 1-877-424-1300

Fax: 519-826-7610

E-mail: ag.info.omafr@ontario.ca

Appendix C.
Ontario Ministry of the Environment Regional Contact Information

REGION County	Address	Telephone/Fax
CENTRAL REGION Toronto, Halton, Peel York, Durham	5775 Yonge St., 8th Floor Toronto, ON M2M 4J1	Tel: 416-326-6700 Toll-free: 1-800-810-8048 Fax: 416-325-2459
WEST-CENTRAL REGION Haldimand-Norfolk, Niagara, Hamilton-Wentworth, Dufferin, Wellington, Waterloo, Brant	Ontario Government Building 119 King St. West, 12th Floor Hamilton, ON L8P 4Y7	Tel: 905-521-7640 Toll-free: 1-800-668-4557 Fax: 905-521-7820
EASTERN REGION Frontenac, Hastings, Lennox & Addington, Prince Edward, United Counties of Leeds & Grenville, Prescott & Russell, Stormont/Dundas & Glengarry, Haliburton, Peterborough, City of Kawartha Lakes, Northumberland, Renfrew, Ottawa-Carleton, Lanark, (Township of South Algonquin)	1259 Gardiners Rd., Unit 3 PO Box 22032 Kingston, ON K7M 8S5	Tel: 613-549-4000 Toll-free: 1-800-267-0974 Fax: 613-548-6908
SOUTHWESTERN REGION Elgin, Middlesex, Oxford, Essex, Kent, Lambton, Bruce, Grey, Huron, Perth, Simcoe	733 Exeter Rd., 2nd Floor London, ON N6E 1L3	Tel: 519-873-5000 Toll-free: 1-800-265-7672 Fax: 519-873-5020
NORTHERN REGION	Thunder Bay Regional and District Office 435 James St. S., Suite 331 Thunder Bay, ON P7E 6S7	Tel: 807-475-1205 Toll-free: 1-800-875-7772 Fax: 807-475-1754
	Sudbury District Office 199 Larch St., Suite 1201 Sudbury, ON P3E 5P9	Tel: 705-564-3237 Toll-free: 1-800-890-8516 Fax: 705-564-4180
	Timmins District Office Ontario Government Complex Hwy 101 East P.O. Bag 3080 South Porcupine, ON P0N 1H0	Tel: 705-235-1500 Toll-free: 1-800-380-6615 Fax: 705-235-1520
Standards Development Branch	Pesticides Section 40 St. Clair Ave. W., 7th Floor Toronto, ON M4V 1M2	Tel: 416-327-5519 Fax: 416-327-2936
Approvals Branch	Pesticides Licensing 2 St. Clair Ave. W., 12A Floor Toronto, ON M4V 1L5	Tel: 416-314-8001 Toll-free: 1-800-461-6290 Fax: 416-314-8452

Appendix D. Diagnostic Service

Samples for disease diagnosis, insect or weed identification, nematode counts and *Verticillium* testing can be sent to:

Pest Diagnostic Clinic
Laboratory Services Division
University of Guelph
95 Stone Road West
Guelph, ON N1H 8J7

Tel: 519-767-6256
Fax: 519-767-6240
E-mail: pdclsd@uoguelph.ca

Payment must accompany samples at the time of submission. Submission forms are available at: www.labservices.uoguelph.ca/units/pdc/.

Fee Schedule

To obtain information on the fee schedule, visit www.labservices.uoguelph.ca/units/pdc/ or phone the Pest Diagnostic Clinic.

How to Sample for Nematodes

Soil

When to sample

Soil and root samples can be taken at any time of the year that the soil is not frozen. In Ontario, nematode soil population levels are generally at their highest in May and June and again in September and October.

How to sample soil

Use a soil sampling tube, trowel or narrow-bladed shovel to take samples. Sample soil to a depth of 20–25 cm (8–10 in.). If the soil is bare, remove the top 2 cm (1 in.) prior to sampling. A sample should consist of 10 or more subsamples combined. Mix well. Then take a sample of 0.5–1 L (1 pint–1 quart) from this. No single sample should represent more than 2.5 ha (6.25 acre). Mix subsamples in a clean pail or plastic bag.

Sampling pattern

If living crop plants are present in the sample area, take samples within the row and from the area of the feeder root zone (with trees, this is the drip line).

Number of subsamples

Based on the total area sampled:

500 m ² (5,400 ft ²)	10 subsamples
500 m ² –0.5 ha (5,400 ft ² –1.25 acres)	25 subsamples
0.5 ha–2.5 ha (1.25–6.25 acres)	50 subsamples

Roots

For small plants, sample the entire root system plus adhering soil. For large plants, 10–20 g ($\frac{1}{2}$ –1 oz.), dig fresh weight from the feeder root zone and submit.

Problem areas

Take soil and root samples from the margins of the problem area where the plants are still living. If possible, also take samples from healthy areas in the same field. If possible, take both soil and root samples from problem and healthy areas in the same field.

Sample Handling

Soil samples

Place in plastic bags as soon as possible after collecting.

Root samples

Place in plastic bags and cover with moist soil from the sample area.

Storage

Store samples at 5–10°C (40–50°F) and do not expose them to direct sunlight or extreme heat or cold (freezing). Only living nematodes can be counted. Accurate counts depend on proper handling of samples.

Submitting Plant for Disease Diagnosis or Identification

Sample submission forms

Forms can be obtained from your local Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) office. Carefully fill in all of the categories on the form. In the space provided, draw the most obvious symptom and the pattern of the disease in the field. It is important to include the cropping history of the area for the past 3 years and pesticide use records from this year.

Choose a complete, representative sample showing early symptoms. Submit as much of the plant as is practical, including the root system, or several plants showing a range of symptoms. If symptoms are general, collect the sample from an area where they are of intermediate severity. Completely dead material is usually inadequate for diagnosis.

With plant specimens submitted for identification, include at least a 20–25-cm sample of the top portion of the stem with lateral buds, leaves, flowers or fruits in identifiable condition. Wrap plants in newspaper and put in a plastic bag. Tie the root system off in a separate plastic bag to avoid the soil drying out and contaminating the leaves. Do not add moisture, as this encourages decay in transit. Cushion specimens and pack in a sturdy box to avoid damage during shipping. Avoid leaving specimens to bake or freeze in a vehicle or in a location where they could deteriorate.

Delivery

Deliver to the Pest Diagnostic Clinic as soon as possible by first class mail or courier at the beginning of the week.

Submitting Insect Specimens for Identification

Collecting samples

Place dead, hard-bodied insects in vials or boxes and cushion with tissues or cotton. Place soft-bodied insects and caterpillars in vials containing alcohol. Do not use water, as this results in rot. Do not tape insects to paper or send them loose in an envelope.

Place live insects in a container with enough plant "food" to support them during transit. Be sure to write "live" on the outside of the container.



95 Stone Road West
Guelph, ON N1H 8J7
Tel: (519) 767-6256
Fax: (519) 767-6240
Web: www.uoguelph.ca/pdc

Pest Diagnostic Clinic

SAMPLE SUBMISSION FORM

LABORATORY USE ONLY: LS Form: SubP01.04.03 Pg. 1 of 1

Rec'd By: _____ Date Received: _____

Delivered By: ☐ Mail ☐ Courier ☐ In-Person

LS Sample No: _____ to _____

Payment Rec'd: \$ _____ Receipt #: _____

Submitted By: _____ Owner (if different from submitter): _____

Business Name (if applicable): _____ Business Name (if applicable): _____

Street: _____ Street: _____

City: _____ Prov: _____ Postal Code: _____ City: _____ Prov: _____ Postal Code: _____

Tel: () - _____ Fax: () - _____ Tel: () - _____ Fax: () - _____

Email: _____ Email: _____

Unless otherwise indicated, report and invoice will be sent to submitter

Report to: ☐ Submitter ☐ Owner Required Report Format: ☐ Fax ☐ E-Mail ☐ Mail

Invoice to: ☐ Submitter ☐ Owner Quotation #: _____ Purchase Order / U of G G/L code: _____

Services Required: ☐ Nematode Count ☐ Nematode Count from Roots ☐ SCN Cyst & Egg Count
☐ Plant Disease Diagnosis ☐ Insect Identification ☐ Plant Identification ☐ Verticillium Count

Plant or Host Affected: _____ Cultivar/Variety: _____ Grower/Field sample #: _____

Location of Plant (i.e. greenhouse, field, orchard, garden, etc.): _____

Size of Planting: _____ % of Plants Affected: _____ Symptoms First Appeared in Past: _____ Degree of Injury: _____
☐ Days ☐ Weeks ☐ Months ☐ Years ☐ Severe ☐ Moderate ☐ Light

Cropping History: _____ Future Crop: _____

Describe the problem in detail (i.e. symptoms, plant parts affected, distribution of symptoms):

Were chemicals applied? Please specify type of product(s) used and date(s) of application:

Additional comments and specific requests:

Additional Sheet(s) Attached: ☐

Appendix E. Other Contacts

AGRICULTURE & AGRI-FOOD CANADA RESEARCH CENTRES

http://www.agr.gc.ca/index_e.php

Eastern Cereals and Oilseeds Research Centre

960 Carling Ave.

Ottawa, K1A 0C6

Tel 613-759-1858

Greenhouse and Processing Crops Centre

2585 County Road 20

Harrow N0R 1G0

Tel 519-738-2251

Southern Crop Protection and Food Research Centre

http://res2.agr.ca/london/pmrc/index_e.htm

1391 Sandford St.

London N5V 4T3

Tel 519-457-1470

Vineland Research Farm

4902 Victoria Ave. N.

Vineland L0R 2E0

Tel 905-562-4113

Delhi Research Farm

Box 186 Schafer Rd.

Delhi N4B 2V9

Tel 519-582-1950

CANADIAN FOOD INSPECTION AGENCY REGIONAL OFFICES (PLANT PROTECTION)

www.inspection.gc.ca/english/toce.shtml

Belleville

345 College St. E.

Belleville, K8N 5S7

Tel 613-969-3333

Brantford

625 Park Rd. N., Suite 6

Brantford, N3T 5P9

Tel 519-753-3478

Hamilton

709 Main St. W., Suite 101

Hamilton, L8S 1A2

Tel 905-572-2201

London

19-1200 Commissioners Rd. E.

London, N5Z 4R3

Tel 519-691-1300

Ottawa District

38 Auriga Dr., Unit 8

Nepean, K2E 8A5

Tel 613-274-7374, ext. 221

Toronto

1124 Finch Ave. W., Unit 2

Downsview, M3J 2E2

Tel 416-665-5055

UNIVERSITY OF GUELPH

Main Campus

Guelph, N1G 2W1

Tel 519-824-4120

www.uoguelph.ca

Alfred Campus

Alfred, K0B 1A0

Tel 613-679-2218

www.alfredc.uoguelph.ca

Kemptville Campus

Kemptville, K0G 1J0

Tel 613-258-8336

www.kemptvillec.uoguelph.ca

Ridgetown Campus

Ridgetown, N0P 2C0

Tel 519-674-1500

www.ridgetownc.on.ca

Department of Plant Agriculture

www.plant.uoguelph.ca

Department of Plant Agriculture, Guelph

50 Stone Rd. E.

Guelph, ON N1G 2W1

Tel 519-824-4120, ext. 56083 or 52693

Department of Plant Agriculture, Simcoe

1283 Blueline Road, Box 587

Simcoe, N3Y 4N5

Tel 519-426-7127

Department of Plant Agriculture, Vineland

Box 7000, 4890 Victoria Ave. N.

Vineland Station, L0R 2E0

Tel 905-562-4141

Lab Services Division

www.uoguelph.ca/labserv/

95 Stone Rd. W.

Guelph, N1H 8J7

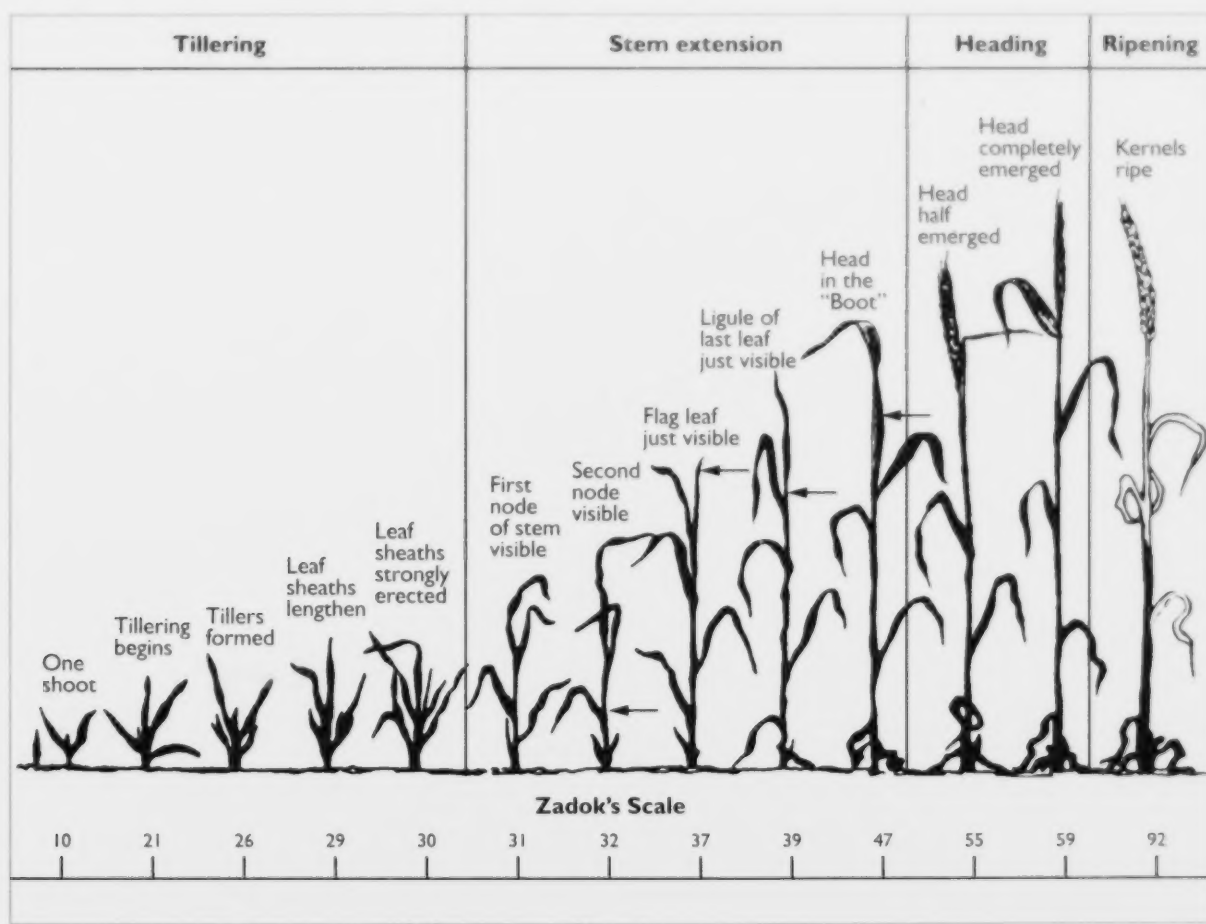
Trace Organic and Pesticide Contaminants

Tel 519-823-1268

Pest Diagnostic Clinic

Tel 519-767-6256

Appendix F.
Cereal Growth Stages



Appendix G.
Pesticide Groups Based on Sites of Action

Group #	Primary Site of Action	Group Name	Product name(s)	Risk of Developing Resistance
Insecticides				
The classification scheme listed below is adapted from the Insecticide Action Committee Mode of Action Classification (IRAC) V5.2, September 2006.				
IA ¹	Acetylcholine esterase inhibitors	carbamate	Furadan 480 F, Lannate, Pirimor 50 DF, Sevin XLR, Vydate L	High
IB		organophosphate	Agrox B-2, Agrox CD, Counter 15 G, Cygon 480, Imidan 50 WP, Lagon 480, Lorsban 4E, Lorsban 15 G, Malathion 500 E, Monitor 480, Pyrifos 15 G, Pyrifos 50 W, Pyrinex 480 EC, Thimet 15 G	High
2A	GABA-gated chloride channel agonists	chlorinated cyclodiene	Thiodan 4 EC, Thiodan 50 WP, Thionex 50 W	Mod
3	Sodium channel modulators	diphenylethane	Kelthane 50 W	High
		pyrethroid	Decis 5 EC, Force 3.0 G, Matador 120 EC, Pounce 384 EC, Ripcord 400 EC, Silencer 120EC	
4	Nicotinic acetylcholine receptor agonists	neonicotinoids	Admire, Gaucho 480 FL, Gaucho GS, Poncho 600, Cruiser 5FS, Cruiser 350FS, Helix Xtra, Prosper	Low to Moderate
5	Nicotinic acetylcholine receptor agonists (allosteric, not group 4)	naturalyte/spinosyns	Success 480 SC, Delegate	Low
9B	Compounds of unknown or non-specific mode of action (selective feeding blockers)	pyridines	Fulfill 50 WG	Low
11	Microbial disruptors of insect midgut membranes	biologicals	Bioprotec CAF, Dipex 2X DF, Novodor, Thurcide HPS	Low
17	Chitin biosynthesis inhibitor (Diptera only)	cyromazine	Citation 75 WP, Governor 75 WP	Low
21	Mitochondrial complex I electron transport inhibitor	botanicals	Rotenone 5, Rotenone 1% WP, Rotenone 5% WP	Low
24	Mitochondrial complex IV electron transport inhibitors	inorganics	Aluminum phosphide	

¹ Although sharing the same primary target site, it is possible that not all members of a single major mode of action (MoA) class have been shown to be cross-resistant. However, for the purposes of this classification system, it should be assumed that cross-resistance exists between compounds in any one sub-group.

Appendix G.
Pesticide Groups Based on Sites of Action

Group #	Primary Site of Action	Group Name	Product name(s)	Risk of Developing Resistance
Fungicides				
This classification scheme is based on the Fungicide Resistance Action Committee (FRAC) List, 2006				
1	Inhibition of mitosis (tubulin formation)	methyl-benzimidazole carbamates	DCT, Senator 70 WP	High
2	Affect cell division, DNA & RNA synthesis & metabolism	dicarboximide	Ronilan EG, Rovral WP	Moderate to High
3	DMI (demethylation inhibitor): inhibition of sterol synthesis	triazole	Baytan 30, Bumper 418 EC, Dividend XL RTA, Folicur 432F, Gemini, Quilt, Stratego, Tilt 250 E, Raxil T, Topas 250 E, Helix Xtra	Moderate
4	Phenylamides affect RNA synthesis	acylamine (phenylamides)	Allegiance FL, Apron FL, Apron XL LS, Apron Maxx, Helix Xtra, Prosper	High
5 ²	Inhibition of an isomerase in sterol biosynthesis	morpholines	Acrobat MZ	Low to Moderate
7	Fungal respiration	carboxamide anilide	Anchor, Lance WDG, Vitaflo 280, Vitavax RS, Gaucho CS, Prosper	Moderate
11	Fungal respiration: quinone outside inhibitors (QOI)	strobilurin	Cabrio EG, Dynasty 100, Headline EC, Quadris, Quilt, Stratego 250EC, Reason 500 SC, Tanos 50 DF	High
12	Osmotic signal transduction	phenylpyrroles	Maxim 480 FS, Apron Maxx, Helix Xtra	Low to Moderate
14	Lipid peroxidation (proposed)	aromatic hydrocarbon chlorophenyl	Botran 75 W, Quintozene 75 WP	Low to Moderate
22	Mitosis and cell division	benzamide	Gavel 75 DF	Low to Moderate
25	Protein synthesis	antibiotic	Streptomycin	High
27	Unknown	cyanoacetamide oxime (acetamide)	Curzate 60 DF	Low to Moderate
28	Cell membrane permeability (proposed)	carbamate	Tatoo C	Low to Moderate
33	Unknown	phosphonate	Alette WDG	Low
M1	Multi-site, contact	inorganic	Copper Spray, Copper 53 W, Kocide 101 WP, Kocide DF, Microscopic Sulphur, Oxidate, Parasol WP	Low
M2	Multi-site, contact	dithiocarbamate	Anchor, Acrobat MZ, Dithane, Dithane F 45, Ferbam 76 WDG, Gavel 75 DF, Manzate DF, Penncozeb 80, Polyram DF, Ridomil Gold, Thiram 75 WP, Vitaflo 280, Vitavax RS, Zineb 80 W, Gaucho CS, Prosper, Gemini	Low
M3	Multi-site, contact	phthalimide	Agrox B-2, Agrox CD, Captan, DCT, Maestro 75 DF, Supra Captan 80 WDG	Low
M4	Multi-site, contact	chloronitrile	Bravo 500, Tatoo C	Low

² Depending on the reference sources, the cinnamic acid group may be listed as a group 5 or group 15.

Appendix H. The Metric System

Metric Units	
Linear Measures (length)	
10 millimetres (mm)	= 1 centimetre (cm)
100 centimetres (cm)	= 1 metre (m)
1,000 metres	= 1 kilometre (km)
Square Measures (area)	
100 m x 100 m = 10,000 m ²	= 1 hectare (ha)
100 ha	= 1 square kilometre (km ²)
Cubic Measures (volume)	
Dry Measure	
1,000 cubic millimetres (mm ³)	= 1 cubic centimetre (cm ³)
1,000,000 cm ³	= 1 cubic metre (m ³)
Liquid Measure	
1,000 millilitres (mL)	= 1 litre (L)
100 L	= 1 hectolitre (hL)
Weight-Volume Equivalents (for water)	
(1.00 kg) 1,000 grams	= 1 litre (1.00 L)
(0.50 kg) 500 g	= 500 mL (0.50 L)
(0.10 kg) 100 g	= 100 mL (0.10 L)
(0.01 kg) 10 g	= 10 mL (0.01 L)
(0.001 kg) 1 g	= 1 mL (0.001 L)
Weight Measures	
1,000 milligrams (mg)	= 1 gram (g)
1,000 g	= 1 kilogram (kg)
1,000 kg	= 1 tonne (t)
1 mg/kg	= 1 part per million (ppm)
Dry-Liquid Equivalents	
1 cm ³	= 1 mL
1 m ³	= 1,000 L

Application Rate Conversions		
Metric to Imperial (Approximate)		Dry Weight Equivalents
litres per hectare x 0.09	= gallons per acre	Grams/Hectare Ounces/Acre
litres per hectare x 0.36	= quarts per acre	100 = 1½
litres per hectare x 0.71	= pints per acre	200 = 3
millilitres per hectare x 0.015	= fluid ounces per acre	300 = 4¼
grams per hectare x 0.015	= ounces per acre	500 = 7
kilograms per hectare x 0.89	= pounds per acre	700 = 10
tonnes per hectare x 0.45	= tons per acre	Kilograms/Hectare Pounds/Acre
Imperial to Metric (Approximate)		1.10 = 1
gallons per acre x 11.23	= litres per hectare (L/ha)	1.50 = 1¼
quarts per acre x 2.8	= litres per hectare (L/ha)	2.00 = 1½
pints per acre x 1.4	= litres per hectare (L/ha)	2.50 = 2¼
fluid ounces per acre x 70	= millilitres per hectare (mL/ha)	3.25 = 3
tons per acre x 2.24	= tonnes per hectare (t/ha)	4.00 = 3½
pounds per acre x 1.12	= kilograms per hectare (kg/ha)	5.00 = 4½
ounces per acre x 70	= grams per hectare (g/ha)	6.00 = 5¼
Liquid Equivalents		7.50 = 6¼
Litres/Hectare	Approximate Gallons/Acre	9.00 = 8
50	= 5	11.00 = 10
100	= 10	13.00 = 11½
150	= 15	15.0 = 13¼
200	= 20	Metric Conversions
250	= 25	5 mL = 1 tsp
300	= 30	15 mL = 1 tbsp
		28.5 mL = 1 fl. oz

Conversion Tables: Metric to Imperial**Length**

1 millimetre (mm)	= 0.04 inch
1 centimetre (cm)	= 0.40 inch
1 metre (m)	= 39.40 inches
1 metre (m)	= 3.28 feet
1 metre (m)	= 1.09 yards
1 kilometre (km)	= 0.62 mile

Area

1 square centimetre (cm ²)	= 0.16 square inch
1 square metre (m ²)	= 10.77 square feet
1 square metre (m ²)	= 1.20 square yards
1 square kilometre (km ²)	= 0.39 square mile
1 hectare (ha)	= 107,636 square feet
1 hectare (ha)	= 2.5 acres

Volume (dry)

1 cubic centimetre (cm ³)	= 0.061 cubic inch
1 cubic metre (m ³)	= 1.31 cubic yards
1 cubic metre (m ³)	= 35.31 cubic feet
1,000 cubic metres (m ³)	= 0.81 acre-foot
1 hectolitre (hL)	= 2.8 bushels

Volume (liquid)

1 millilitre (mL)	= 0.035 fluid ounce
1 litre (L)	= 1.76 pints
1 litre (L)	= 0.88 quart
1 litre (L)	= 0.22 gallon (Imp.)
1 litre (L)	= 0.26 gallon (U.S.)

Weight

1 gram (g)	= 0.035 ounce
1 kilogram (kg)	= 2.21 pounds
1 tonne (t)	= 1.10 short tons
1 tonne (t)	= 2.205 pounds

Pressure

1 kilopascal (kPa)	= 0.15 pounds/in ²
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Speed

1 metre per second	= 3.28 feet per second
1 metre per second	= 2.24 miles per hour
1 kilometre per hour	= 0.62 mile per hour

Temperature

$$^{\circ}\text{F} = (^{\circ}\text{C} \times \frac{9}{5}) + 32$$

Conversion Tables: Imperial to Metric**Length**

1 inch	= 2.54 cm
1 foot	= 0.30 m
1 yard	= 0.91 m
1 mile	= 1.61 km

Area

1 square foot	= 0.09 m ²
1 square yard	= 0.84 m ²
1 acre	= 0.40 ha

Volume (dry)

1 cubic yard	= 0.76 m ³
1 bushel	= 36.37 L

Volume (liquid)

1 fluid ounce (Imp.)	= 28.41 mL
1 pint (Imp.)	= 0.57 L
1 gallon (Imp.)	= 4.55 L
1 gallon (U.S.)	= 3.79 L

Weight

1 ounce	= 28.35 g
1 pound	= 453.6 g
1 ton	= 0.91 tonne

Pressure

1 pound/square inch	= 6.90 kPa
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Temperature

$$^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times \frac{5}{9}$$

Abbreviations

%	= per cent (by weight)	km	= kilometre
ai	= active ingredient	km/h	= kilometres per hour
AP	= agricultural powder	kPa	= kilopascal
cm	= centimetre	L	= litre
cm ²	= square centimetre	m	= metre
DG	= dispersible granular	m ²	= square metre
DP	= dispersible powder	mL	= millilitre
E	= emulsifiable	mm	= millimetre
e.g.	= for example	m/s	= metres per second
EC	= emulsifiable concentrate	SC	= sprayable concentrate
F	= flowable	SP	= soluble powder
g	= gram	t	= tonne
Gr	= granules, granular	W	= wettable (powder)
ha	= hectare	WDG	= water dispersible granular
kg	= kilogram	WP	= wettable powder

Appendix I.

Field Record Form

YEAR _____

	Field I.D.				Field I.D.				Field I.D.				Field I.D.			
Acreage																
Soil Type																
Soil Fertility	pH	N	P	K	pH	N	P	K	pH	N	P	K	pH	N	P	K
Tillage																
Variety/Hybrid																
Seeding Rate																
Seeding Date																
Seed Treatment																
Fertilizer/Lime product, rate, timing																
Manure Application																
Herbicides																
Rate																
Crop Stage																
Date																
Yield																
Harvest Date																
Moisture																
Test Wt/Grade																
Notes																

Emergency and First-Aid Procedures for Pesticide Poisoning

For a major spill, a theft or a fire involving a pesticide call the Ministry of the Environment at **1-800-268-6060**.

For pesticide poisonings and pesticide injuries call the Poison Information Centre:

Toronto

1-800-268-9017

Hearing Assistance (TTY)

1-877-750-2233

PREVENT ACCIDENTS

- **Read the label.** Follow all the precautions the label recommends. Read the First Aid section of the label **BEFORE** you begin to handle any pesticide.
- **Make sure that someone knows** what pesticides you are working with and where you are.
- **Keep a file of labels and product Material Safety Data Sheets (MSDS) for the pesticides you use.**
Make sure everyone knows where to find this in case of an emergency.
- **Post emergency numbers near all telephones.**
- **Keep clean water, paper towels, extra gloves and clean coveralls close by** in case you spill pesticide on yourself.

If someone has been working with pesticides and you see any possible symptoms of pesticide poisoning or injury, take emergency action immediately.

FIRST AID

If a pesticide comes in contact with skin:

- remove all contaminated clothing; wash skin thoroughly with lots of soap and warm water
- dry skin well and cover with clean clothing or other clean material.

If pesticide comes in contact with eyes:

- hold eyelids open; wash the eyes with clean running water for 15 minutes or more.

If pesticide was inhaled:

- move the victim to fresh air and loosen tight clothing
- give artificial respiration if the victim is not breathing.

Do not breathe in the exhaled air from the victim — you could also be poisoned.

If a pesticide was swallowed:

- call the Poison Information Centre **IMMEDIATELY**.

Emergency numbers are listed at the front of each Bell telephone directory.

IF AN ACCIDENT OR POISONING HAPPENS

- Protect yourself from injury first.
- Stop the exposure to the pesticide. Move the victim away from the contaminated area.
- Check the four basic facts — identify the pesticide, the quantity, the route of entry and time of exposure.
- Call an ambulance or the Poison Information Centre.
- Start first aid. This is not a substitute for professional medical help.
- **Provide the label, MSDS sheet or container to emergency personnel at the scene — or take it with you to the hospital.** Do not transport pesticide containers in the passenger compartment of the vehicle.

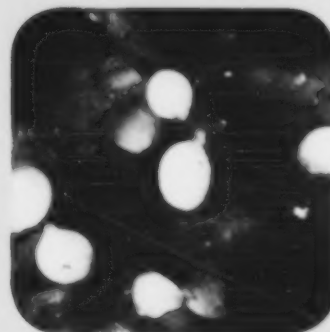
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